# WARRANTY

Products sold by us, unless otherwise specified, are warranted for a period of one year from date of shipment or delivery to be free of defects in materials and workmanship. If any defects should occur in the product during this period of warranty, we will repair or replace the defects parts or product free of charge

This warranty shall not apply to defects resulting from following actions:

1) Improper or inadequate operation, maintenance, adjustment or calibration.
2) Unauthorized modification or misuse.
3) Use of parts that are not supplied by us.
4) Disaster.
5) Consumable parts such as fuse, battery and fittings.

The warranty period for all parts and repairs supplied under this warranty expires with the warranty period of the original product. For inquiries concerning repair service, contact your supplier after confirming the model name and serial number of your instrument. The contents of this manual are subject to change without notice in accordance with product improvements.

This operation manual describes the operation over the life of this instrument, carefully read this manual to obtain a through understanding of the operation of the unit before attempting to use it.

Special consideration and precautions for safe and efficient use are also described throughout the manual. These appear in the following forms;

***WARNING !*** : Warns potentially hazardous situations and outlines the correct procedures or practices required to prevent from personal injury.

***CAUTION !*** : Alert the operator to the correct operating or maintenance procedures required to prevent instrument failure, or damage.

***NOTE !*** : Provides additional information for operator to obtain the best performance from the instrument.

Pressurized and hazardous solvents are used in high performance liquid chromatography. Take care to follow proper laboratory procedures to insure operator safety. Always wear eye, skin and clothing protection when operating the instrument, especially during sample injection, the opening of values, etc.

# Gradient Pump

## User Manual

YOUNG LIN INSTRUMENT

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# I. Introduction

The Younglin Gradient Pump was designed and fabricated as pump for high performance liquid chromatograph requiring exact, precise solvent delivery, and has very diverse function and excellent performance.

As the Gradient Pump controlled by microprocessor involves gradient program, gradient program of various curves may be executed using the Gradient Pump by connecting 3 instruments or using solenoid valve. And, the Gradient Pump has frequency output function, so it may be connected to similar product of other company which may be operated by receiving frequency input from other instrument.

The Gradient Pump is a precise small quantity pump, which is able to indicate constant pressure operation and elapsed time, cumulative liquid delivery quantity, relative viscosity, etc. as well as to realize control of various input and output and program execution with involved event program and RS232C communication. This enables execution of operation connected with the autosampler, remote operation using computer, etc. The Gradient Pump is equipped with cam and damper devised especially to exert high level liquid delivery performance as well as function, and it has compression ratio compensating function(high speed operation) to improve precision and accuracy of flow rate simultaneously.

On the other hand, it has washing port of same type as head in pump head for durability of instrument and uses high density fluoro-resin seal, so that life of seal is largely extended even in solvent using buffer. It has in-line filter at outlet to prevent small particles from entering into column in order to protect column, and is able to set upper and lower limit of pressure and flow rate. In addition, the Gradient Pump has a function of prime/purge and key locking for convenience of user.

### ◎ Major features of the Gradient Pump Gradient Solvent Delivery Pump

1. Wide flow rate range and excellent flow rate linearity
2. Realization of ultra-precise liquid delivery by compression ratio compensating operation
3. Selection of 16 types of gradient curves of low pressure and high pressure by involvement of gradient program
4. Execution status control pursuant to proceeding of time with involved event program
5. Constant pressure and constant flow selection operation
6. Indication of elapse time, accumulated flow and relative viscosity
7. Integrated configuration and convenient use

## ◎ Specifications of the Gradient Pump Gradient Pump

**Solvent delivery** : dual plunger, pulse compensating operation

**Solvent delivery mode** : isocratic, constant pressure, gradient and external input

**Head volume** : cleaning part integrated 64 μ L x 2

**Flow rate range** : 0.001 ~ 16.0ml/min

**Flow rate accuracy** : 2%(at 1.0ml/min)

**Maximum pressure** : 6000psi(0 ~ 420 bar)

**Flushing** : Automatic every 3 minute

**Solvent compressibility compensation** : high speed even compensating operation type

**Material of liquid contacting part** : SUS316, zirconium, sapphire, ruby, UHMWPE

**Gradient table** : 10 step 10 file, at least 999.9 minutes per 1 file,
16types of curves and linearity

**Number of gradient channel** : 3 channels (frequency is used)
4 channels (Vacuum Degasser & Mixer used)

**Valve operation method** : phase compensating random circulation method

**Solvent mixing ratio** : 0-100%(program execution capability 0.01%)

**Event table** : at least 999.9 minutes per 1 file for 10 step 10 file, change of gradient/event execution status, connected outside switch operation, waiting operation, alarm program

**External control input** : frequency input, instrument stop and start, marker for event execution control, RS232C communication

**External output** : RS232C, frequency output 2 channel, pressure value and gradient curve, relative viscosity(1.0 VFS and 10mVFS)

**Power requirement** : AC 110V or 220V ±10% , 50/60Hz

**Size** : 297mmW x 198mmH x 495mmD

**Weight** : Approximate 27kg

Specifications are subject to change without notice for improvement.

[**Fig 1.1.**] The Gradient Pump

# 2. Configuration and principle

## 2.1 Configuration

The Gradient Pump is configured as follows in order to satisfy all functions and performance as a gradient pump for HPLC.

**1) Keyboard and LCD(liquid crystal display)**

This enables all operations of instrument to be performed easily while confirming it through 20 characters x 2 line LCD(liquid crystal display) using keyboard. Detailed method for operation of key is described in chapter 4.

**2) Prime/purge valve**

Prime/purge valve is used for providing new solvent into flow path of pump using common injector. When using for the first time or not using for long time, insert solvent into pump head using prime/purge valve. It is possible to change solvent using prime function of keyboard during use of instrument ; but this function make pump operate in fine speed, so it is better to use prime/purge valve.

**3) Mobile phase filter and in-line filter**

Use filter in order to protect system from small particles during operation. Mobile phase filter extends life of high pressure seal by blocking small particle entering solvent first, and in-line filter prevents small particles generated through non-filtration in first stage and wear of seal from entering column and shortening life of column.

**4) Terminal board**

This is used to connect surrounding equipment such as solenoid valve, switch, autosampler, etc. for constant pressure gradient.

**5) Pump head assembly**

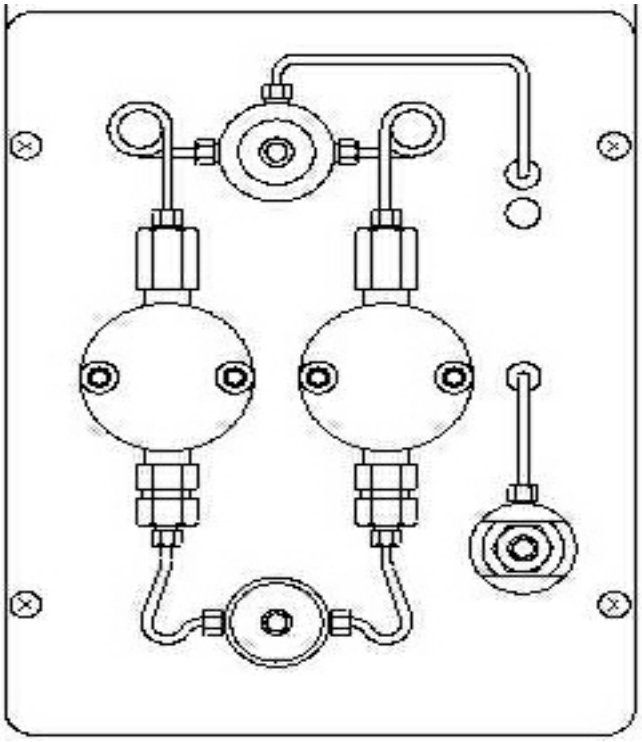
Pump head is a device to deliver solvent through check valve and reciprocation of piston, which is composed of check valve, washing port and high pressure seal, washing port and low pressure seal, etc. Pump head assembly is equipped with washing port, which may be used efficiently for using buffer solution.

**6) Main circuit panel**

The panel is equipped with electronic circuit part related to microprocessor control to realize diverse functions of the Gradient Pump.

**7) Motor operation and power circuit panel**

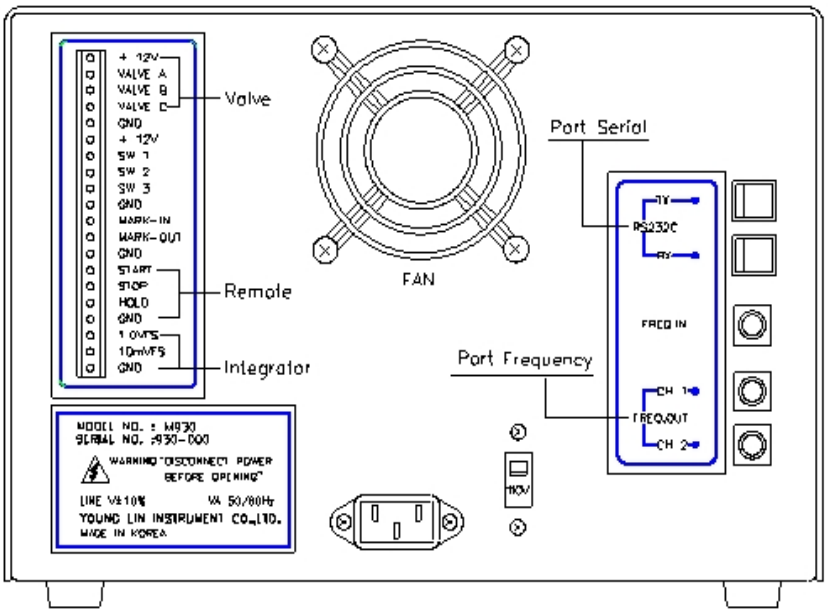
It is equipped with stepping motor control circuit and power circuit to drive motor. Stepping motor control circuit drivers motor by micro-step, so it is possible to obtain constant motor speed even in lower noise and lower flow rate than common control circuit.



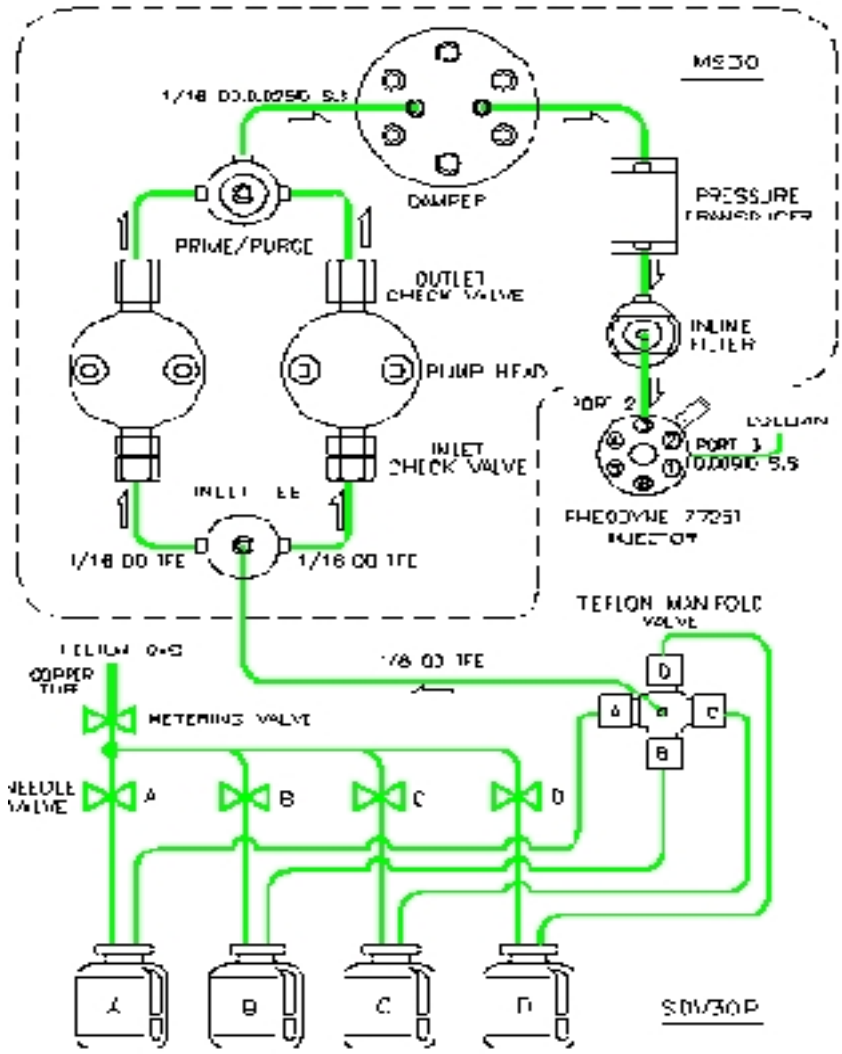
[**Fig 2.1.**] The Gradient Pump Head

**8) Driving mechanism**

This is a device to change kinetic energy generated from step motor into reciprocation motion and transfer it to pump head. This device uses especially designed cam so that occurrence of pulse in flow rate may be minimized even through single head pump, and is composed of stepping motor for driving, piston carrier, carrier housing, cam location sensor, etc.




[**Fig 2.2.**] The drawing of the Gradient Pump rear panel




[**Fig 2.3.**] The flow diagram drawing of the Gradient Pump

**9) Flow Diagram**

The flow path diagram of the Gradient Pump is illustrated on FIG 2-3. Teflon tubing is used for inlet check valve of pump head, and SUS316 tubing is used thereafter.

**10) Pulse damper**

The Gradient Pump uses diaphragm damper, which reduces pulse generation of pump and serves as the mixer for solvents in high pressure gradient. The Gradient Pump ensures precise flow rate with compression ratio compensating program only, so that trouble is not caused for result of analysis without damper in case gradient analysis is unnecessary or in case detector is not sensitive to pulse.

**11) Pressure sensor**

This is used to protect instrument from excessive pressure and realize constant pressure drive and compressibility compensating drive by reading pressure between performances. Pressure sensor of the Gradient Pump is designed as continuous flow path type so as to be suitable for use for HPLC.

**12) Auto-flushing motor**

It is used for automatic flushing the Gradient Pump inside with 20% methanol(for example) every 3 minute.

## 2.2 Operation method

The Gradient Pump used for liquid chromatograph requires excellent flow rate precision, flow rate accuracy and flow rate reproducibility in order to enhance reliability of analysis data and characteristics of detection limit. The Gradient Pump minimized generation of pulse by using diaphragm pulse damper and especially designed cam and realizing high speed suction through microprocessor in order to satisfy such requirement.

Diaphragm pulse damper remarkably reduces pulse generated instantly up to 90% or more from low pressure to high pressure range with charged liquid serving as damper, and serves as mixer in gradient analysis. Compressive property of diaphragm pulse damper improves flow rate precision by making liquid(iso-propanol) filled inside distribute change of kinetic energy due to flow rate of mobile phase even through compression and expansion processes. The quantity of mobile phase contacting with pulse damper is only 1.2ml at 6000psi, which ensures that flow path is completely cleared away.

The Gradient Pump was designed so that integrated flow rate may realize no-pulse operation using specially designed cam. However, pulse incapable of being neglected is caused actually due to compressibility of mobile phase proportional to pressure and elasticity of high pressure seal, so the Gradient Pump is controlled in real time so that occurrence of pulse proportional to pressure may be depressed. Control method of the Gradient Pump uses supervision of pressure and control of location simultaneously, so it has advantage to improve precision and accuracy of flow rate without being affected by range of pressure and flow rate.

## 2.3 Compensation of compressibility

Most of pumps for HPLC analysis are used at high pressure. However, pulse occurs in high pressure due to compressibility of liquid and elasticity ratio of seal, so flow rate is also reduced. Occurrence of pulse due to this reduces precision and accuracy of pump flow rate, so compensation is necessary for this. The Gradient Pump reads actual pressure and calculates compensation value for this; compressibility compensating operation to control angular velocity of cam with this value reduces occurrence of pulse flow remarkably as well as improves accuracy of flow rate largely.

## 2.4 Opening and closing of valve

The Gradient Pump outputs valve opening and closing signal to terminal board so that gradient analysis may be performed at low pressure as high pressure. The Gradient Pump compensates speed of valve circulation opening and closing pursuant to location of cam in low pressure gradient as well as suction interval is broadly distributed, so exact gradient ratio is transferred.

## 2.5 Gradient curve

The Gradient Pump can edit 10 gradient programs of 10 lines for gradient analysis. Gradient curve whose shape is obtained by the following exponential equation may be selected and inputted for each line. Gradient curve may be applied for both of gradient and flow rate. If solvent B is introduced and mixed to solvent A at flow rate $F_b$ and mixed solvent flows to column at flow rate $F_{ab}$, concentration of solvent B is :

$$c(\%) = 100 \times (1 - \{(F_{ab}-F_b)\} \text{ over } V \times t)^{(Fb/Fab-Fb)} \{(1 - (F_{ab}-F_b) \text{ over } V \times t)^{(Fb/Fab-Fb)}$$

In the event that the above equation is actually applied, the difference between gradient ratio of current line and gradient ratio(or flow rate) of next line is the form of the above exponential curve which

increases and decreases.

## 2.6 Washing port

When using buffer solution, salts are generated on back side of high pressure seal and these deposits wear pump seal to cause shortening of seal life, which has bad effect on pump.
Washing port enables to insert proper solvent in back side of high pressure seal to prevent salts from being deposited and activated. Mixed solution(20% MeOH) of water and methanol is used as cleaning solution, and life of seal is extended with lubrication action in general analysis.

# 3. Installation and preparatory test

## 3.1 Inspection and installation

The Gradient Pump is delivered along with the following parts when being shipped. Before opening transportation package, perform inspection for trace of shock or mistake, and if there is abnormality, do not open the contents and inform this company of it. And, if contents are opened, perform inspection for existence of shock in the contents and contact with this company when trace of shock is found.

The Gradient Pump is a delicate instrument, so use original box and buffer material as far as possible when re-packing it to transport instrument. If it is impossible to use original box; wrap pump with several layers of buffer material, and fill the bottom, top and all other sides of pump with buffer material in order to make pump endure shock or vibration during transportation.

**Standard configuration of the Gradient Pump**

1) Body of instrument
2) Power source code
3) SUS316 tubing 60cm
4) 2 sets of ferrule, male nuts
5) Operation manual

**Site requirement of the Gradient Pump**

1) Room with 20℃ temperature with variation ± 5℃ with and 60% humidity
2) Where no direct and straight sunlight
3) Plain floor without carpet
4) Where having spare space of 20cm or more
5) Where there are 10% or less voltage change, no frequency change and 100Ω or less grounding point
6) Where there is no generation of corrosive gas and ventilation is well done
7) Where stable power of 110 or 220V is supplied
8) Where not receiving electromagnetic induction from large transformer, high frequency heater, UPS, etc.

There are a power input, a power transition switch and a fuse holder on the real panel of gradient pump. The fuse specification is 1 A when uses 220V. Be sure to be careful on the power volt you use before turning on the pump. The Gradient Pump is set at 220V during shipping. In case of using 110V, change location of power selection switch and use.

## 3.2 Mobile phase filter and vessel

Solvent vessel should be positioned at higher location than pump and not be positioned below pump, and inlet tubing length should be as short as possible. This can minimize pressure drop caused at inlet of pump during suction.

When using solvent having high vapor pressure as hexane, formation of air bubble is caused due to large pressure drop in suction part in high flow rate; so particular care should be taken, and mobile phase should be maintained after air separation, filtration and air-tightening.

Mobile phase filter of 10 μm porosity is inserted into inlet tubing in order to prevent entering of small particles. Mobile phase filter is blocked if mobile phase is bad or is used for long time, it is necessary to clean or change filter in this case.

## 3.3 Preparation of solvent

Proper solvent prevents various problems caused during actual analysis. Solvent gas removal and filtration are necessary because they have great effect on result of analysis and maintenance of instrument.

**1) Degassing**

Solvent gas removal is performed in order to remove gas such as nitrogen or oxygen contained in mobile phase. Contained gas should be removed by air separation before mobile phase is used or while mobile phase is used, and the most practical technology for air separation is to insert helium into solvent.

Helium is easily separated from HPLC solvent, so other gases contained in solvent may be easily removed due to diffusion of helium gas.
Filtration of solvent using vacuum pump is not a effective method than helium separation, but it is said to be a helpful method. When separating air using helium, insert it severely for 10 or 15 minutes before using solvent and maintain proper injection status during use. If air is separated from solvent before use, gas in the atmosphere is melted into mobile phase within 4 hours. Helium purity used should be 99.9% standard laboratory grade.

When mixing organic solvent such as methanol or acetonitrile into water, this mixture contains very small quantity of gas as compared to the quantity of pure composition; so it has more strong tendency to discharge gas. Back pressure regulator attached to outlet of detector prevents formation of noise in

base line due to air bubble, and mobile phase vessel should be pressurized under 2-3psi pressure with helium if it is desired to reduce gas discharge due to solvent mixing.

**2) Filtration**

Solvent should be necessarily filtered through 0.45 μm or less filtering membrane before use. Removal of small particles is necessary to compensate reliable operation of piston seal, and is necessary measure for reliability of other components in liquid chromatograph.

Filtration process is necessary after mixing of solvent, and is more necessary in case of buffer to which un-dissolved impurities are source of deposits. After filtration, solvent should be keep in air-tight bottle from which small particles are removed; once solvent has been filtered, it is not necessary to filter this solvent everyday unless reaction produce bacteria or indissoluble material occurs. If solvent is kept in storage vessel for more than one week, it is desired to filter it again before use.

**3) Solvent effect on the instrument**

All parts of the Gradient Pump contacting with mobile phase is manufactured from 316 stainless steel, ruby, sapphire, zirconium, or fluorine carbon polymer. Most of these materials are sensitive to chloride, and it is desired to avoid use of solvent which contains even small quantity of chloride. Main solvents which should be avoided especially are as follows.

| | |
|---|---|
| Aqua Regia | Hydrochloric Acid(HCL) (20%) |
| Bromine | HCL (37%) |
| Chlorine Anhydrous | HCL (50%) |
| Copper Chloride | HCL (20%) |
| Ferric Chloride | HCL (75%) |
| Ferrous Chloride | Hydrofluorsilicic Acid (20%) |
| Freon 12 | Hydrogen Peroxide |
| Guanidine | Lodine |
| Hydrochloride (6M) | Mercuric Chloride |
| Hydrobromic (20%) | (Dilute Solution) |

In addition, it should be avoided to leave chloroform, carbon tetrachloride, etc. in instrument for long time, and use of ammonium hydroxide should be avoided because it has effect on stator and rotor of injector even though it has no effect on pump. When not using it for long time, keep it with iso-propanol filled with in flow path.

**4) Measures when not uses for long time**

① Prepare iso-propanol for analysis.

② Open prime/purge pump and suck iso-propanol of at least 50ml into instrument.

③ Separate outlet tubing of pump.

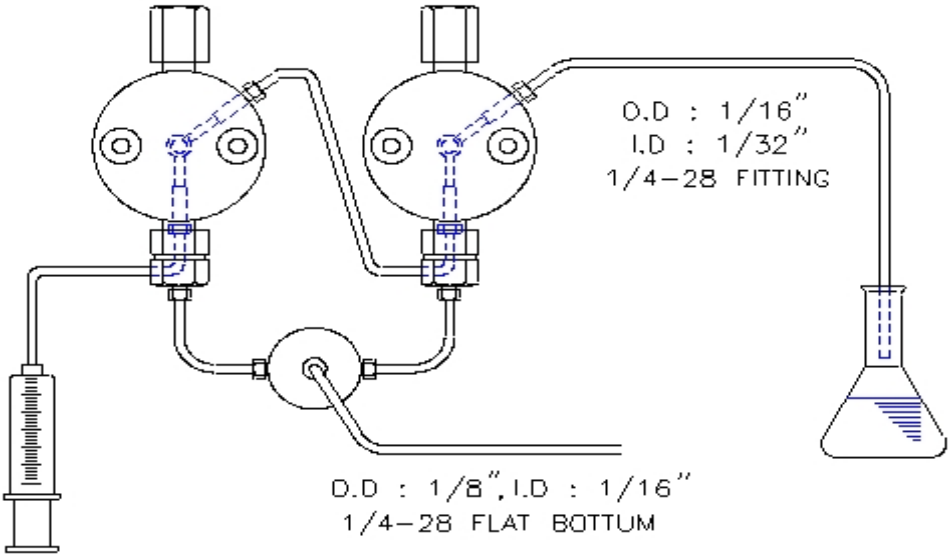
④ Press out iso-propanol sucked into syringe in prime/purge valve and discharge at least 5ml into outlet of in-line filter.

⑤ Separate mobile phase filter assembly and block discharge hole and suction hole with cap.

## 3.4 Connection of tubing

The following tubing and fitting are used as standard size in flow path of the Gradient Pump.

| Material | OD | ID | fitting size(UNF size) |
|---|---|---|---|
| 1) SUS316 | 1/16" | 0.02" | 10-32 |
| 2) Teflon | 1/16" | 1/32" | 1/4-28(plain bottom) |
| 3) Teflon | 1/8" | 1/16" | 1/4-28(plain bottom) |




[**Fig 3.1.**] The tube connection of the washing port

Item 1) is used for tubing from outlet check valve to in-line filter and injector, item 2) is used for washing port, and item 3) is used for tubing connected to mobile phase filter and inlet check valve housing. Standard of tubing may be used by changing it with proper one depending on flow rate and pressure used.

Generally, in case it is used at low flow rate or delivery volume should be small, one of narrow inner diameter may be used ; but it is recommended to use proper size because it may be cause to reduction of accuracy of flow rate due to large pressure difference in suction process of solvent in high flow rate.

On the other hand, the standard of 1) is used for connection of the Gradient Pump and injector for analysis, and tubing of 0.01" inner diameter is used on the back side of injector. The cut surface of tubing should be cut at right angle without dust, tube should not be contracted, and middle inner diameter shall not be blocked.

In order to cut stainless steel tubing, tubing cutter should be used, plastic tubing cutter or shaving cutter should be used for teflon and similar material of tubing, and the surface should be clean and have no crumbling.

Connect tubing of washing port with 1/4-28 fitting as figure 6, inject 20% methanol of 10ml to 20ml into outlet of bottom side using common syringe to make methanol flow out, and then make piston cleaned automatically using natural load drop. Because cleaning liquid is much consumed due to increase of cleaning liquid flow rate if drop difference is large, it is desired to reduce consumption of cleaning liquid by reducing drop difference.

In case of re-using cleaning solution having come out, check change period by inspecting base concentration with litmus test paper and prevent contamination of cleaning part by replacing it with very clean new solution.

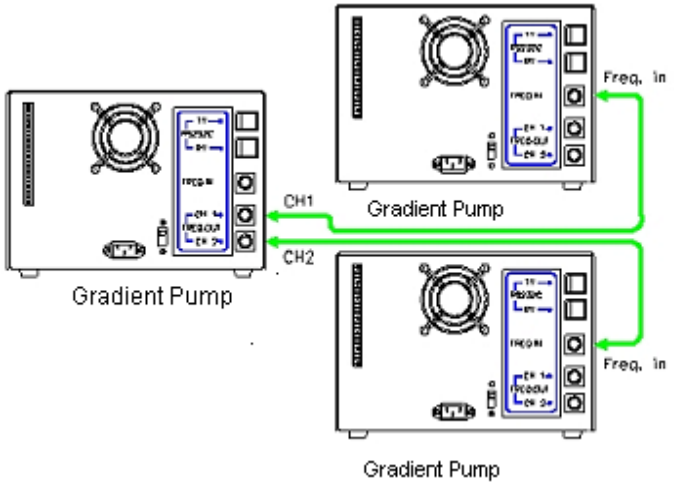
## 3.5 Initialization of the Gradient Pump

When using pump for the first time, initialize it through the following process in order to clean flow path and condition high pressure seal. This process is necessary in case instrument is installed newly or is not used for long time.

1) Preparation of iso-propanol for analysis.
2) Remove residual air bubble within instrument by turning prime/purge valve in counter clockwise and loading iso-propanol of at least 50ml with injector.
3) Separate pump outlet tubing.
4) Press the sucked iso-propanol into injector with prime/purge valve and discharge more than 5ml to outlet of in-line filter.
5) Operate pump with instrument outlet open for 2-3 hours at 0.2ml/min flow rate and for 1 hour at 1.0ml/min flow rate using iso-propanol.
6) Perform process of 2) using solvent which is desired to be used.

7) Remove inside residual iso-propanol by operating it at 1ml/min flow rate for 30 minutes with instrument outlet open.

8) Form flow path by connecting injector, column, and detector tubing mutually.




[**Fig 3.2.**] The connection of frequency I/O terminal for the Gradient Pump

## 3.6 Connection of the frequency in-and-out terminal cable

The Gradient Pump has frequency input function to be used as slave pump by connecting The Gradient Pump can perform high pressure gradient by connection with other manufacturer's pump which is able to receive 5V TTL input because setting of frequency output range proportional to flow rate is possible. In order to connect it to the product of other company, it is necessary to take care in electrical connection. Please contact the manufacturer for details. In case of performing gradient using the Gradient Pump, frequency range of slave, proportional flow rate, and related designation value are described in detail in chapter 4.

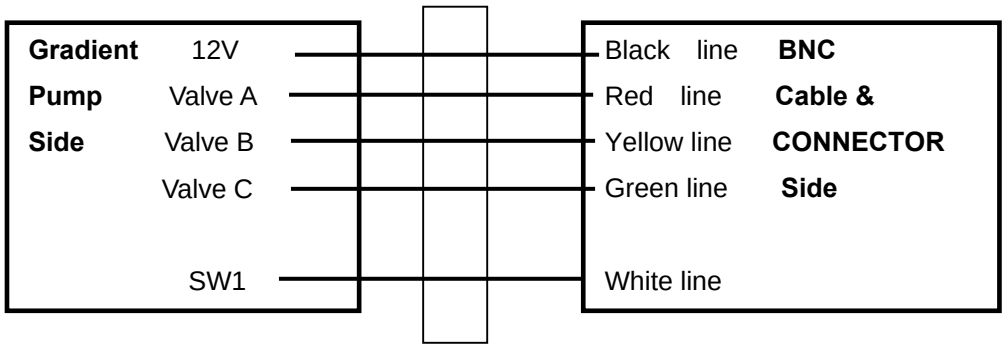
## 3.7 Connection of the Vacuum Degasser & Mixer

The Gradient Pump has terminal board which is able to connect solenoid valve and switch in order to perform low pressure gradient. Solenoid valve and switch may be connected for 12V, and output is disconnected when on if it is connected with 0V.

The Gradient Pump is configured suitably for three solvents gradient generally, but gradient ratio for %D solution is output to SW1 terminal board in order to make four solution gradient possible. This is

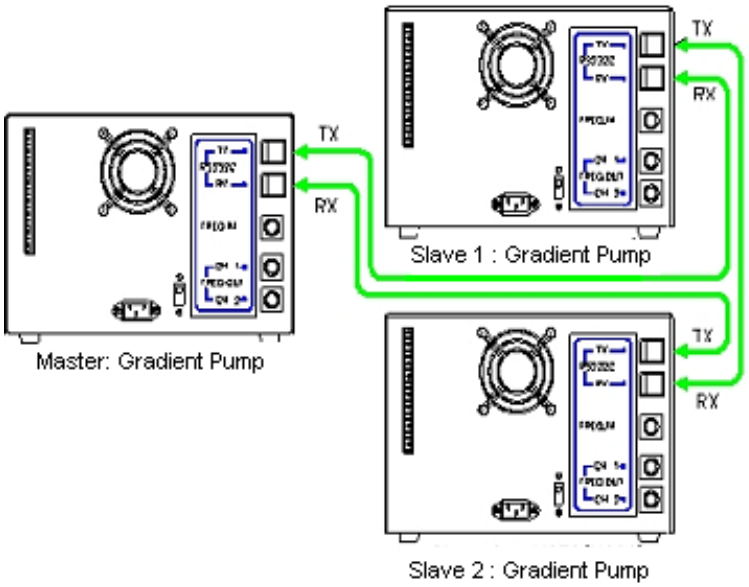
operated only if sum of gradient ratios of three solutions is less than 100%.

| | |
|---|---|
| 12V | 12V solenoid valve and switch power source |
| VALVE1 | gradient ratio A output |
| VALVE2 | gradient ratio B output |
| VALVE3 | gradient ratio C output |
| 0V | Valve or switch output grounding |
| 12V | 12V solenoid valve and switch power source |
| SW1 | gradient ratio D output or switch 1 output |
| SW2 | Switch 2 output |
| SW3 | Switch 3 output |




## 3.8 Connection of RS232C communication cable

The Gradient Pump has communication function so as to perform high pressure gradient by connecting up to 3 sets of the Gradient Pump, and is able to perform major function of Gradient Pump using RS232C with computer. Command is described in chapter 4. Communication cable is connected by taking RX and TX as chain loop type. That is, when connecting each pump, closed loop is made by connecting TX and RX; when connecting it with computer , one TX output among each pump is connected to RX pin and RX pin is connected to computer TX pin. And, in case of using computer, Gradient Pump should be in slave mode ; in case of using Gradient Pump by connecting each other, there should be only one master pump. More detailed content for this is described in chapter 4.




[**Fig 3.3.**] The connection of RS-232 cable for the Gradient Pump

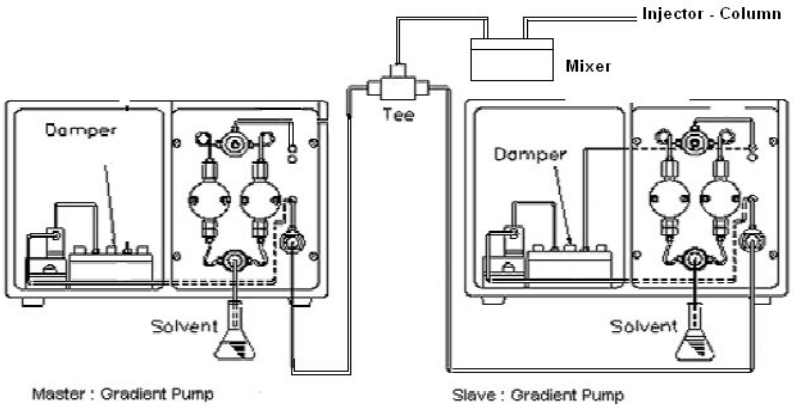
## 3.9 Connection of injector and terminal panel

START, STOP, MARK-OUT and HOLD of the terminal panel are used for automatic repetitive analysis with the autosampler.

**START** : operates instrument and perform gradient program and event program together in gradient mode
**STOP** : stops instrument
**MARK-IN** : can control event program during gradient with this input condition.
**MARK-OUT** : can control output with event program during gradient.
**HOLD** : in case the Gradient Pump is started and prepared to perform analysis, HOLD output is disconnected. Using this condition, waiting status of objective instrument may be induced.

## 3.10 Tubing connection in high pressure gradient

In case of performing high pressure gradient using the Gradient Pump, it is desired to change tubing connection in order to make solvent mixed well.
At this time, pump outlet used as slave should be connected to tubing to enter damper of inside of instrument in master side using TEE or CROSS.




[**Fig 3.4.**] The tube connection of high pressure gradient configuration for the Gradient Pump

# 4. Operation

## 4.1 Key function

The keyboard of the Gradient Pump is consisted of function keys and number keys. The function keys are as follows and each function is described.

**1) START/STOP** : Used for starting or stopping the run of Gradient Pump which is operation on Run Mode. On Isocratic or Constant Pressure Mode, press 2 times, stops the Gradient Pump and press 1 time more, starts the Gradient Pump. On Gradient Mode, press 1 time turns to standby state. One more time press starts gradient run of the Gradient Pump and then 2 times press during gradient run stops the Gradient Pump.

**2) CLR/SCL** : Used for clear the setting value or scrolling the selection value. Also used for clearing the limit for pressure or flow which are already set. Also used for change the LCD display of the Gradient Pump.

**3) ▲, ▼** : Used for moving a cursor to display during Isocratic Mode and Constant Pressure Mode and for moving a cursor to editing line during Program Event Mode and Gradient Mode. Also used for moving editing line up and down.

**4) ENTER** : Used for input of value and parameter scrolled.

**5) PURGE** : Used for quick removal and change of solvent in the Gradient Pump. Works only when pressing the key during the pump stops while the LCD displays as follows. When pressing the key, the Gradient Pump runs at high speed so be sure to open the prime/purge valve.

| PRIME / PURGE !! |
| --- |
| Execute..... |

**4) ●** : Used for recalling another file number during Gradient Mode and Event Mode. Also used for input of a decimal point when input values.

## 4.2 Mode Selection

There are two modes selectable, Editing Mode and Run Mode on the Gradient Pump operation. Each Mode is selected by pressing the corresponding operation keys and then Enter key. For example, if press the GRAD. key, following message is displayed and the mode is selected by pressing the ENTER key.

| PROGRAM GRAD. FILE<br>Mode Select? Yes |
|---|

If press the CLR/SCR key following pressing the GRAD. Key, following display is appeared and by pressing the ENTER key, then changing mode is cancelled and returned to the first mode.

| PROGRAM GRAD. FILE<br>Mode Select? No |
|---|

However, Run Mode is always effective during Editing Mode. All parameter settings work immediately and are not removed after re-starting the Gradient Pump by switching on/off.

[**Table 4.1.**] Various Modes and their operation for the Gradient Pump

| Mode | Description | Mode | Description |
|---|---|---|---|
| ISOCRATIC | Isocratic Mode with constant flow and constant mixing time | CONFIGURATION | Input the values for configuration of the pump |
| GRADIENT | Gradient Mode with gradient and event file | SET UP | Input of calibration factors for display of pressure limit, flow rate limit and relative viscosity |
| CONSTANT PRESSURE | Maintain constant pressure inside pump by adjusting flow | PROGRAM GRADIENT | Edit the gradient file by each line |
| SYSTEM SLAVE | Set as slave Mode by frequency in-and-out and serial communication | PROGRAM EVENT | Making or editing a file for gradient Mode condition according to elapsed time |

## 4.3 Starting and Power On

On switching on the pump, following messages are displayed in sequence and the self-diagnostics is done.

| YOUNGLIN SP930D |
| --- |
| Solvent Delivery Pump |

| YOUNGLIN |
| --- |
| INSTRUMENT |

If previous values saved at SRAM are not valid or press the Enter key, the edited values are initialized and set-up as defaults. In case SRAM is in defect,

| VER1.10 SELF TEST |
| --- |
| CMOS Backup Fail! |

In case the operator press the Enter key,

| VER1.10 SELF TEST |
| --- |
| CMOS Backup Clear! |

On initializing,

| VER1.10 SELF TEST |
| --- |
| Data Initialize .. |

In case no malfunctions or after initialization,

| VER1.10 SELF TEST |
| --- |
| OK! |

If you turn on the power of the pump with pressing Config. Button, the QC set up is on processing and the pump will ask you of maximum flow, maximum pressure and, maximum motor frequency, etc..

| VER1.10 SELF TEST |
| --- |
| Max. Flow: 16ml/min |

After input of all these values, the calculated pump head volume is displayed for short a while and the pump is operated accordingly. Therefore, be sure to confirm the pump head volume and ask us if the volume is different from the one that you purchased.

If the pump is used as a master pump and uses RS-232C for gradient Mode, the system checks connection for communication with a slave pump.

| Serial Slave Check<br>..... Accepted. |
|---|

| Serial Link Check<br>Out of Time. |
|---|

After initialization is finished, the pump is run at isocratic mode. If the pump was set up as a slave, it will be run as a slave.

## 4.4 CONFIGURATION

The values on the configuration are already factory set. Understand clearly what each value means. The default values should not be changed without special reason. On the configuration, there are the values for maximum flow rate, gradient Mode with two or more pumps and calibration factor for constant flow rate or constant mixing rate operation. Meanwhile, an operator can not change the values for the pump itself where no cursor is occurred.

As for special reason, an operator can change by pressing the CONFIG key just after switching on but ask us for details.

The configuration can be seen after passing identification by input of password. If want to change the password, press the CONFIG key and then the CLEAR key and input new password you want. The default password is **9 3 0 .**.

| Password? [****] |
|---|

After passing identification, an operator can input the values for the pump configuration itself in sequence. The values already set-up are replacements when the SRAM backup fails. If change the values, they affect the Gradient Pump operation, so be sure to clearly understand what they mean.

**1) Gradient Channel Selection on the Slave Mode**

Display : %A

Selection ; %A, %B, %C

When more than 2 Gradient Pumps are used for high pressure gradient operation. Each pump should be set up as a master and slaves. Following is instructions how to set up each pump.

| | SP930D CH1 | CH2 |
|---|---|---|
| %A | %A %B | %C |
| %B | %B %A | %C |
| %C | %C %A | %B |

**2) Designation of ID for communication**

Display : Instrument ID : 1
Input range : 1-8

Designate the ID via RS-232C. If the received ID is different from, the Gradient Pump transmits the communication over TX. Also if the protocol is different, the Gradient Pump does not handle. If the Gradient Pump is set as a slave, designate the ID not to overlap for correctly communication.

**3) Selection of communication parameters**

Display : RS232C : 9600, n, 8, 1
Selection : 9600, 19200, 38400

For RS-232C communication, should select the baud rate. 9600 or 19200 according to desired rate. Date configuration is 8 bit, parity is none and stop bit is 1.

**4) Selection for gradient mode**

Display : Grad. Tool : Valve4
Selection : Serial, Freq, Valve3, Valve4

If run the Gradient Pump in high pressure gradient by RS-232C, select “Serial” and by frequency in and out, select “Freq.”. If run the Gradient Pump in low pressure gradient, select "Valve3" for 3 solvents and "Valve4" for 4 solvents.

**Note**) If you select "Valve3" total sum of % solvent should be 100%. However, if you select "Valve4", total sum of % solvent is not necessary to be 100% and remaining value is output to SW1 output.

**5) Selection for the Gradient Pump as a slave**

Display : Slave Link : Serial
Selection : Serial, Freq.

Select connection between the Gradient Pumps. If the Gradient Pumps are connected via RS-232C, select "Serial". Flow rate and gradient profile are transferred directly to the master Gradient Pump via

RS-232C. If the Gradient Pumps are connected via Frequency in and out, select "Freq.". Flow rate is transferred to the master Gradient Pump after conversion of frequency to flow rate.

**6) Setup of maximum flow rate**

Display : Max. Flow : 16.0 ml/min
Input range : .001 ~ 16.0
If want to change, input desired value.

**7) Setup of maximum frequency**

Display : Max. Freq.: 38400Hz
Input range : 320-64000

**8) Setup of maximum pressure**

Display : Max. Pres.: 9000
Input range : 80-16000 (for psi unit)

**9) Setup of frequency and flow rate for external output**

Display : Max. Freq. Conv. CH 1 :
40000 Hz- 20.0 ml/min
Max. Freq. Conv. CH 2 :
40000 Hz- 20.0 ml/min
Input range for frequency : 320-64000 Flow rate range : 0.1 - 200

If the Gradient Pumps are connected by frequency in and out for high pressure gradient, the Gradient Pump outputs frequency in proportion to gradient ratio via DIN output on the rear of the Gradient Pump. Input maximum frequency and its corresponding maximum flow rate.

**10) Setup of origin point at Even Compensation Mode**

Display : DPL 90 DPR 270
Input range : DPL<82-98>, DPR<DPL+176 - DPL+184>

If want to change original point at Even Compensation Mode, input desired value. However, check real pressure change before changing the value as the change affects operation. Be careful not to input any value which is not checked or tested. DPL is for left head and DPR is for right head of the Gradient Pump.

**11) Setup of compensation factor, intercept and valve position compensation**

Display : CFB: 4 CFV: 18

Input range 1) Intercept 1-16

2) Correction factor : 1-32

The correction factor is for the end point of pressure compensation at 2000psi(=140bar) and the intercept is for the end point of pressure compensation at 0 psi(= 0 bar).

**12) Setup of proportional differential and integral control value for isocratic mode**

Display : PID Set > Gain=0.36

P=0.24 I=4.80 D=0.12

Input range : 0.01-9.99

Input of constant values according to PID trace at isocratic mode.

**Gain** : Setup for response gain. If the input value is higher, excessive response is increased and if the input value is lower, response is slow.

**P** : Setup for response proportional coefficient corresponding flow rate.
As Gain does, Excessive response is increased and if the input value is lower, response is slow.

**I** : Setup for compensation between real pressure and setup pressure. If the input value is higher, hunting appearance is occurred and if the input value is lower, stabilization time is increased.

**D** : Setup for preventing from rapid excessive response. If the input value is higher , time for reaching integration is increased and the input value is lower, is sensitive to external turbulence.

**The values from 10) to 12) can not be changed on the normal Configuration mode. These can be changed only on the QC configuration mode. If you change these value, the system can not work properly.**

## 4.5 ISOCRATIC MODE

After switch on, the Gradient Pump is automatically setup as an isocratic mode unless the Gradient Pump is previously used for a slave mode. If succeed to setup as an isocratic mode, following is displayed.

| Flow Rate:.000ml/min |
|---|
| %A:100 %B: 0 %C: 0 |

▲and ▼keys are used for moving lines and the [CLR/SCL] key is used for change the display.

**1) Setup flow rate**

Display : Flow Rate: .000ml/min

Input rage : .000 - 16

**2) Setup solvent ratio**

Display : %A: 100 %B: 0 %C: 0
Input range : 0 ~ 100 for all channels. The total sum should be 100 if use 3 solvents but can be less than 100 if use 4 channels. The difference is output via SW1 terminal.

**3) Display of current pressure**

Display : Pressure : 0 psi (or 0.0bar)
Current pressure is displayed as psi or bar.

**4) Display of maximum pressure limit**

Display : Hi. Limit : 6000psi(or 420.0 bar)
Maximum pressure limit is displayed.

**5) Display of minimum pressure unit**

Display : Low Limit : 0psi(or 0.0 bar)
Minimum pressure limit is displayed.

**6) Terminal switch on/off**

Display : S1:Off S2:Off S3:Off
Selection : On, Off
S1 is used for display of gradient rate of channel 4 if used.

**7) Display of accumulated volume and pressure**

Display : Volume Acc. 0.0 μl
Input range : The input of 0 ~ 100.0 can be possible when the Gradient Pump is stopped. When the unit is set as μl, input 100.0 then changed to the unit of 0.1 ml. The accumulated volume is displayed upto 999.9Lit.

**8) Elapsed time and input**

Display : Lapse Time 0.0 min
Input range : 0-999.9

**9) Display of relative viscosity**

Display : Viscosity Ratio N/A
Displays the relative viscosity calculated by reference value and current pressure and flow rate. If the viscosity is over range of 0.01 ~ 9.9 or the Gradient Pump is stopped, N/A is displayed.

## 4.6 GRADIENT MODE

The Gradient Mode is used for running gradient operation of the Gradient Pump. The gradient is run as per a gradient file and an event program file. If select this mode to run, the Gradient Pump ask you of followings.

**1) Input of the gradient file number to run**

| | |
|---|---|
| Display | Grad. File No.: 0 |
| Input range | 0-19 |

**2) Input of repetition START number for a gradient file**

| | |
|---|---|
| Display | Max. Chain No.? |
| Input range | 1-999 |

**3) Input of the event file number to run**

| | |
|---|---|
| Display | Event File No.? 0 |
| Input range | 0-19 |

After input all of above values, the Gradient Pump runs for gradient operation. At the gradient mode, key and its operation is as follows. Press the CLR/SCR, one of following displays will be displayed.

Display (1)

| | ID | Time | Flow Pres. |
|---|---|---|---|
| 01 | 0.1 | 1.00 | 1930 |

Display (2)

| | Time | %A | %B | %C CV |
|---|---|---|---|---|
| 1.00 | 100 | 0 | 0 | 05 |

Display (3)

| F# | Time | S1 | S2 | S3 |
|---|---|---|---|---|
| 01 | 0.0 | on | off | off |

If press the • key, open a new gradient file and an event program file to edit and also set up the repetition run number.

Consecutive pressure of the START/STOP key work as follows.

At Standby status, one press of the key changes to initial status.
At Initial status, one press of the key changes to run status for gradient
At Run status, one press of the key, warning is appeared for "Now Gradient Mode" and 2 consecutive pressures of the key changes to initial status.

## 4.7 CONSTANT PRESSURE MODE

The mode runs the Gradient Pump by maintaining constant pressure while the isocratic mode runs by maintaining constant flow rate. So input the pressure that you want to operate and upper and lower range of flow rate, then current flow rate will be displayed. Other factors are same with those of the isocratic mode.

**1) Input of the pressure that want to operate**

Display Pres. Set : 1000psi
Input range 0 ~ maximum pressure
The Gradient Pump adjust flow rate to maintain the input pressure.

**2) Display of current flow rate**

Display Act. Flow 1.00ml/min
Current flow rate is displayed

**3) Display of upper limit of flow rate**

Display Hi. Limit : 10.0ml/min

**4) Display of lower limit of flow rate**

Display Low Limit: 0.00ml/min

## 4.8 SLAVE MODE

The mode run the Gradient Pump by input of flow rate from the master Gradient Pump via serial or frequency in and out. Pressure of the CLR/SCl key shows current pressure and flow rate.

| SYSTEM SLAVE |
| --- |
| Serial Input HPG %B |

If the pump is on the Slave mode, it can not be controlled by keyboard. Only controlled by master pump or Autochro-2000(or Autochro-3000) software.

## 4.9 SETUP MODE

If select the setup mode, first you can see the selection of key lock function. If select the key lock by pressing Yes, shows you the mode which is currently running. If the key is locked, have to return to the current run mode and can not use key operation further until the key lock is unlocked. Press **9 3 0 •** sequentially for unlock.

| Key Lock : No |
| --- |

If you select the Key Lock to No, you can see the setup menu as below.

**1) Display of upper and lower limit of pressure**

Display

| * Pressure Limit *<br>High : 6000psi |
|---|

| * Pressure Limit *<br>Low : 0psi |
|---|

The maximum value of upper pressure limit should be inputted within the maximum pressure limit of system(6000psi) which are already setup and larger by 10 psi(or 0.7 bar) than the upper limit of pressure. The minimum value of lower limit of pressure should be lower by 10 than the upper limit of pressure. If input "0" it means no lower limit you apply.

In case current pressure is higher than maximum upper pressure, the Gradient Pump immediately stops, so if you want to clear the limit, pressure the key CLR/SCR.

**2) Input of upper and lower limit of flow rate**

Display

| * Flow Rate Limit *<br>High : 10.0ml/min |
|---|

| * Flow Rate Limit *<br>Low : .001ml/min |
|---|

Input range : The upper limit is lower than maximum flow rate and the lower limit is 0. Input of lower limit to "0" means no application of lower limit.

In case current flow rate is higher than maximum upper limit, the Gradient Pump immediately stops, so if you want to clear the limit, pressure the key CLR/SCR. Input of "0" means no application of flow rate.

**3) Input of Viscosity Conversion Value**

Display

| Ref.Viscosity : 1.00 |
| --- |
| Test Flow:1.00ml/min |

| Ref.Viscosity : 1.00 |
| --- |
| Disp.Pres: 1000 psi |

Input range : 0.01 ~ 9.99.

Reference viscosity can be within 0.01-9.99, Test flow can be within .001-100.0mL/min and Display pressure at Test flow can be setup within 10-9000 psi(0.7-630 bar). At Isocratic and Constant Pressure Mode, the value will be displayed by following calculation.

$$\text{Relative Viscosity Ratio} = \text{Viscosity input} \times \frac{\text{Flow rate at input} \times \text{Current pressure}}{\text{Pressure at input} \times \text{Current pressure}}$$

**4) Change of Pressure Unit**

Display Pressure Unit : psi

Selection psi, bar

Select the unit you want to display

**5) Selection for Even Compensation**

Display Even Compensate : Yes

Selection Yes, No

If select "Yes", the Gradient Pump runs by compensated flow rate which is compensated by even compensation value and current pressure.

**6) Selection for Even Compensation Mode**

Display Pressure Trace : No

Selection Yes, No

Selection of "Yes", Gradient Pump runs by pressure compensation.

**7) Input of Value for Flow Rate Calibration**

Display Flow Calib. : 1.00

Input range 0.80 - 1.25

Calibrate the difference between real flow rate and setup flow rate.

**8) Change of Pressure Display Scale**

Display Pressure Scale : 1.00

Input range 0.5-2.0

In case pressure displayed is not same with real pressure, input the difference value for calibration.

**9) Selection of DA Voltage Output**

Display Chart out : Pressure

Selection Pres., %A, %B, %C, Flow, Visco, Curve, SL-CH1, SL-CH2

Output of pressure, mixing rate, flow rate, viscosity, gradient curve and frequency ratio between channel 1 and channel 2 via analog output terminal.

**10) Setup of DA Voltage Output Offset**

Display Chart Offset : 420 (0-1000)

Input range 0 - 9999

Input of offset value for DA voltage output

**11) Setup of DA Voltage Output Gain**

Display Chart Scale: 1.00

Input range 0.01 - 9.99

Input gain value of DA output

**12) Change of Zero Point for Pressure**

Display Pressure Zero : No

Input range Yes, No

Changes the zero point of current pressure output. As the offset value of a pressure sensor can be largely changed by temperature and pressure, recommended to re-setup the zero offset after drop pressure.

**13) Setup of Auto-flushing**

Display Rinse Operate: Yes

Selection Yes, No

Select "Yes" if you want to clean the Gradient Pump inside by an auto-flushing pump built-in inside. It flushes every 3 minutes.

## 4.10 GRADIENT PROGRAM MODE

Creates and edits a file(s) for gradient operation. As the mode, the Gradient Pump asks you the number of a file and if you want to create or edit a file. Can select any file number from 0 to 20.

| Grad. Table No.: 0 |
|---|
| Clear Table : No |

When clears a file, flow rate is set to 0, %A mixing rate to 100%, and other channels' mixing rate also set to 0%. Other lines except the first line are cleared. Open another file during editing mode, press the • key then returns to the above display. When open a file, following table are displayed on the LCD screen. It is one of examples, if want to create a new file, please clear.

Example

| ID | Time | Flow | %A | %B | %C | CV |
|---|---|---|---|---|---|---|
| 00 | init | 1.00 | 100 | 0 | 0 | * |
| 01 | 0.1 | 1.10 | 60 | 40 | 0 | 05 |
| 02 | 12.1 | 1.50 | 40 | 40 | 20 | 06 |
| 03 | 30.5 | 2.00 | 30 | 40 | 30 | 06 |
| 04 | 40.2 | 2.00 | 20 | 40 | 40 | 06 |
| 05 | 100.0 | 1.50 | 10 | 40 | 50 | 06 |
| 06 | 200.8 | 2.00 | 0 | 40 | 60 | 13 |
| 07 | 300.0 | 1.00 | 0 | 30 | 70 | 13 |
| 08 | 500.0 | 1.00 | 50 | 50 | 0 | 15 |
| 09 | 600.0 | 1.50 | 10 | 40 | 50 | 06 |
| 10 | 700.8 | 2.00 | 0 | 40 | 60 | 13 |
| 11 | 999.3 | 1.00 | 100 | 0 | 0 | 19 |

**Item description**

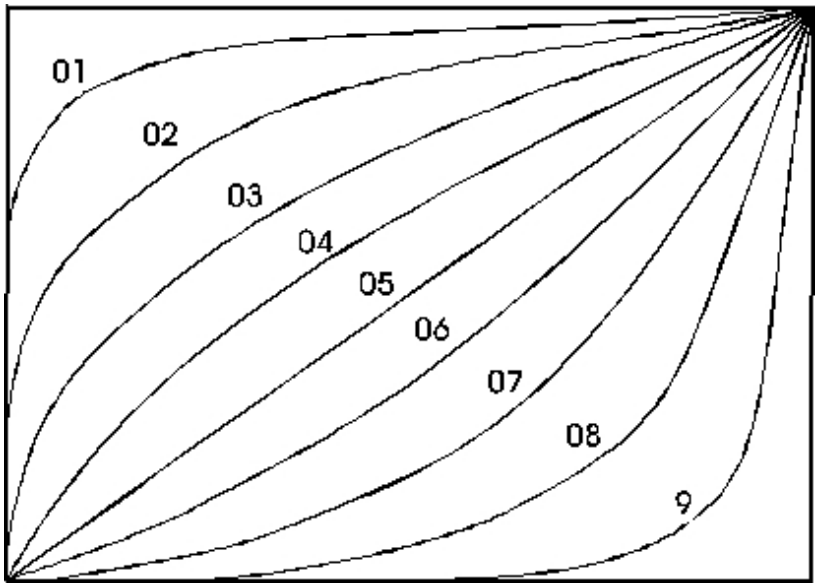
**ID** : for two digits. The first number is for a file number and the second number is for a edit line number. Range is 00 ~ 39.

**Time** : for gradient time from 0 ~ 999.9 in minute

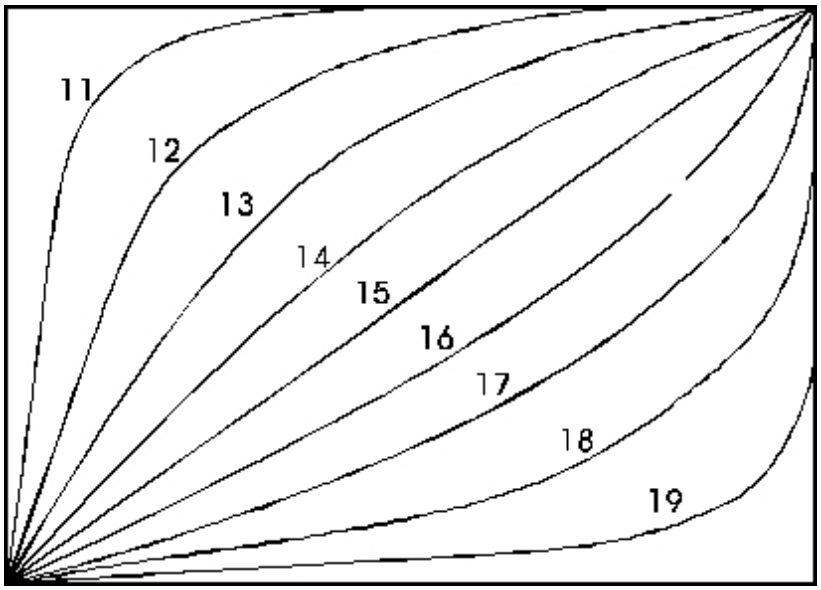
**Flow** : for flow rate from .001ml/min to the maximum flow rate you setup.

**%A, %B, %C** : for mixing rate from 0 to 100

**CV** : for a gradient curve from any of following number you want. CV is applied to flow rate and mixing rate as well. Range is from 00 to 19.




[**Fig 4.1.**] Various gradient curve and its number from 00 ~ 10.




[**Fig 4.2.**] Various gradient curve and its number from 11 ~ 19.

**How to create or edit the gradient table**

**Line editing** : When the cursor is on the ID, press the ENTER key to start input of one line and if return the cursor to the ID, input of the line is finished. If change the operation mode during input, the input on the line is not saved nor effected.

**Line adding** : When the cursor on the time, please input any time you want but not overlapped. After finished the input, the lines are automatically sorted by time. Please do not input over 40 lines. If input by mistake over 40 lines, it will not work.

**Line deleting** : When the cursor on the ID, pressure the CLR/SCR key. However the first line will not be deleted.

**Line moving** : When the cursor on the ID, press the ▲ or the ▼key.

**Opening another file** : Press the • key when the cursor is on the ID.

## 4.11 EVENT PROGRAM MODE

At the mode, you can edit a event file which can change the gradient mode parameters and the external output parameters for the gradient file that you want to change. When you select the mode, the Gradient Pump ask you if you want the file number that you want to change and also if you want to clear the file. Files can be selected from 0 to 20. The event program file is same with the gradient program file to create, edit or save. If some of file numbers are being used or run, the file(s) can not be edited.

| Event File No.: 0 |
| --- |
| Clear File : No |

Key operation for clear, edit, create and edit for file and line is same with that of the gradient program mode. Press the CLR/SCR key to select each item. The items for the event program at the mode are described on the Table 4.2.

[**Table 4.2.**] Various events and their effects and operations.

| Event | Operation | |
|---|---|---|
| Grad | Init | Maintains the first gradient program at initial status of waiting events. |
| | Start | Starts the first gradient program of waiting events |
| | Stop | Stops the Gradient Pump during running. |
| Event | Start | Starts an event program that is on waiting. |
| | Stop | Stops event program(s) which is waiting after the line(However "Event Resume" is not terminated at the command for recovering event runs already done. |
| SW1 | Changes the SW1 terminal output of On, Off or Pulse(200m/s) according to your selection. | |
| SW2 | Changes the SW2 terminal output of On, Off or Pulse(200m/s) according to your selection. | |
| SW3 | Changes the SW3 terminal output of On, Off or Pulse(200m/s) according to your selection. | |
| Mk-out | Changes the mark out terminal output of On, Off or Pulse(200m/s) according to your selection. | |
| Alarm | Changes alarms by On, Off or Pulse(200mS) according to your selection. | |
| Grad. # | Select a gradient file(0 ~ 19) number to run for event program. | |
| Event # | Select an event file(0 ~ 19) number to run for event program. | |

The event program is very useful for repetition run of a gradient or an event program. Please refer to following example to create or edit an event program that you want to run.

**An example for the event program** : After 100 minutes elapse, event file No 1. and gradient file No 2 are subsequently executed.

As for the item "Mark", it can be N/A or Wait. If you select "Wait" the event is started when received the external input such as load of RH7725 manual injector or any other input to designated terminal. The waiting events are executed as per external input not by time. However the waiting events which need same mark out input, the events are executed subsequently. If re-start the event program, all waiting event are neglected.

Event file number 0

| ID | Time | Event | Action | Mark | Explanation |
|---|---|---|---|---|---|
| 00 | INIT | Grad. | Start | N/A | Starts the gradient mode |
| 01 | 10.00 | SW1 | On | Wait | Outputs a pulse via SW1 when received the mark |
| 02 | 10.10 | SW2 | On | Wait | Outputs a pulse via SW2 when received the mark |
| 03 | 15.00 | Mk-out | Pulse | N/A | Outputs a puls via mark out[1] |
| 04 | 20.00 | Event# | 1 | N/A | Changes the event file number to 1 |
| 05 | 20.10 | Grad.# | 2 | N/A | Changes the gradient file number to 2 |
| 06 | 100.00 | Event | Start | N/A | Executes the event table number 01 |

Event file number 01

| ID | Time | Event Action | Mark | Explanation |
|---|---|---|---|---|
| 10 | INIT | Grad. Start | N/A | Starts the gradient program mode |
| 11 | 100.00 | Event Start | N/A | Executes event table number 01 |

**Note 1)** When the mark out terminal is connected to the mark in terminal, you can switch the SW1 and the SW2 on simultaneously. With this function, you can operate simultaneous operation for two external valves or other instruments.

**Note 2)** However, please be careful when use 4 channel valve which is used for the mixing rate of the channel 4. They can not be used together.

## 4.12 Error messages and their causes

Following messages are occurred by error during use or by external input. Table 4.3 describes various error messages and their causes.

[**Table 4.3.**] Various error messages and their cause.

| Error message | Cause |
|---|---|
| High pressure limit | When current pressure is higher than the upper limit at the isocratic, the gradient or the slave mode. |
| Low pressure limit | When current pressure is maintained for 30 seconds lower than the lower limit at the isocratic, the gradient or the slave |
| Flow upper limit | When flow current rate pressure is maintained for 30 seconds higher than the upper limit at the isocratic or the slave mode. |
| Flow lower limit | When flow rate is lower than the limit at the isocratic or the |
| Max. flow limit | When flow rate is higher that the limit at the gradient mode. |
| Communication error | When slave pump is stopped due to protection or When any errors are occurred during communication for decoding, transmission or receipt. |
| Max. frequency Limit | When frequency output is over than the range. |
| Unbalanced limit | When pump head is moving unstable due to air or check |
| Remote start | When start input is from a terminal or RS-232C. |
| Remote stop | When stop input is from a terminal or RS-232C. |

# 5. Maintenance

In the event that problem occurs or it is necessary to change part due to wear of seal in using The Gradient Pump, perform maintenance for instrument by referring to the following items.

## 5.1 Caution of use

In order to protect instrument, take care for the following items in using it.

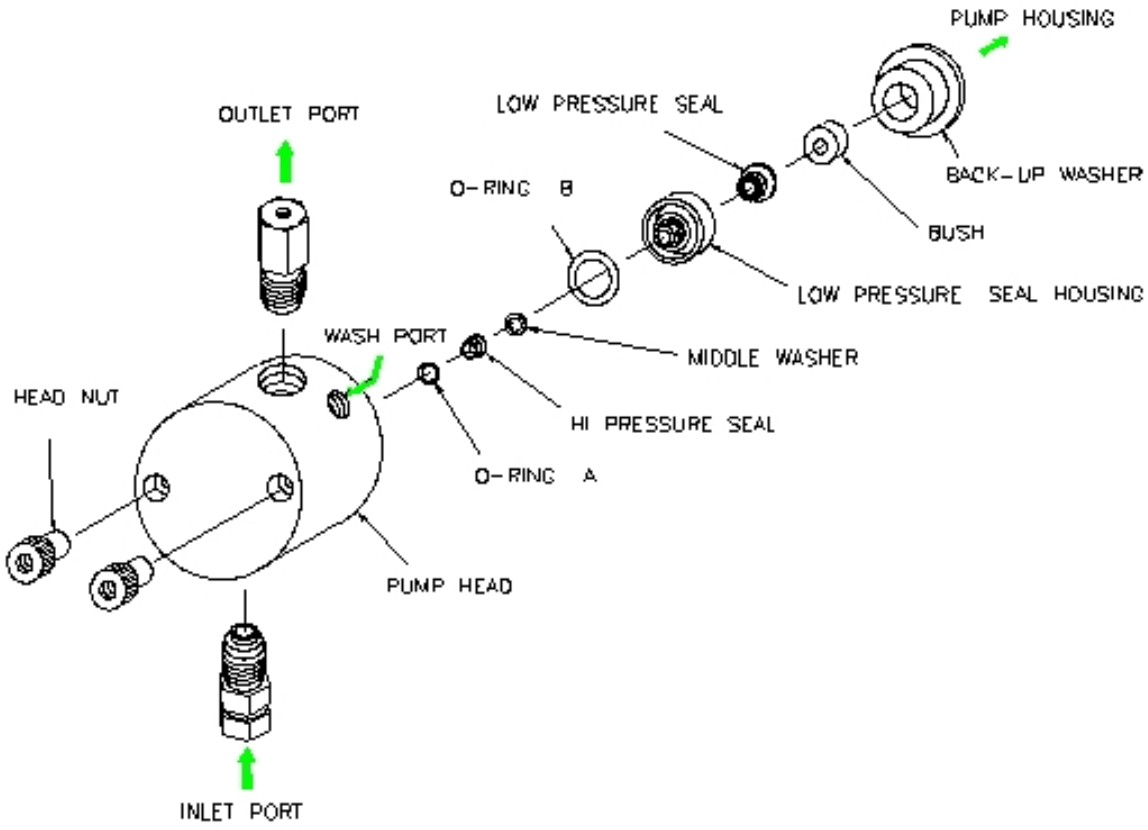
1) After using solvent with sediment such as buffer solution, replace solvent with pure water at first and then methanol or iso-propanol and make it flow for 30 minutes using each solvent at 1.0ml/min flow rate.
2) Do not use solvent to corrode stainless steel material which is less than pH 2.3.
3) Do not install instrument where corrosive gas is generated or where there is carpet on floor.
4) Do not change flow rate rapidly in order to prevent from wrong operation of instrument, damage to column and damage to damper.
5) Do not operate instrument with excessive force.

## 5.2 Change of high pressure seal and conditioning

If instrument is used for long time, high pressure seal is worn out to produce leakage of solution. In this case, after replacing it with new seal, it is necessary to condition it in order to make seal be used for long time at high pressure. Change and condition high pressure seal in the following method. In case instrument is used for the first time after purchasing, it is desired to perform training and it is better to change all seals of both head when change seal due to long use. Leaked liquid flows out through washing port.

**Change of high pressure seal**

1) Loosen tubing of inlet check valve and outlet check valve of pump head.
2) Press pump head to main body of instrument with hand, and loosen head nut.
3) Separate pump head assembly from instrument. At this time, screen and plunger are left at the place where pump head assembly was loosened. When loosening it, pull it carefully in pump head guide direction and take care not to damage plunger.
4) If backup washer in back side of pump head is pulled out, low pressure seal assembly appears. Use seal insertion/removal tool to separate low pressure seal assembly. Then, high pressure seal appears inside of head.




[**Fig 5.1.**] The replacement of the high pressure seal

5) Remove worn seal with seal insertion/removal tool and insert new high pressure seal prepared at that place using seal insertion/removal tool in the same manner. Direction of seal should be such that the direction to see O-ring is toward front of head. Be careful not to change direction.

6) Insert low pressure seal assembly and backup washer.

7) Arrange pump head so that plunger left at the place where it is loosened be inserted into center hole of pump head assembly, and then press pump head to main body by inserting pump head by hand. When pressing it, press it carefully so that pump head may be maintained horizontal.

8) Tighten head nut in pressed condition. Tighten it so that left side and light side may be same, and tighten it until it is tightened no more by hand while confirming status of tightening finally.

9) Change high pressure seal by applying the process of 1 to 8 to pump head of opposite side.

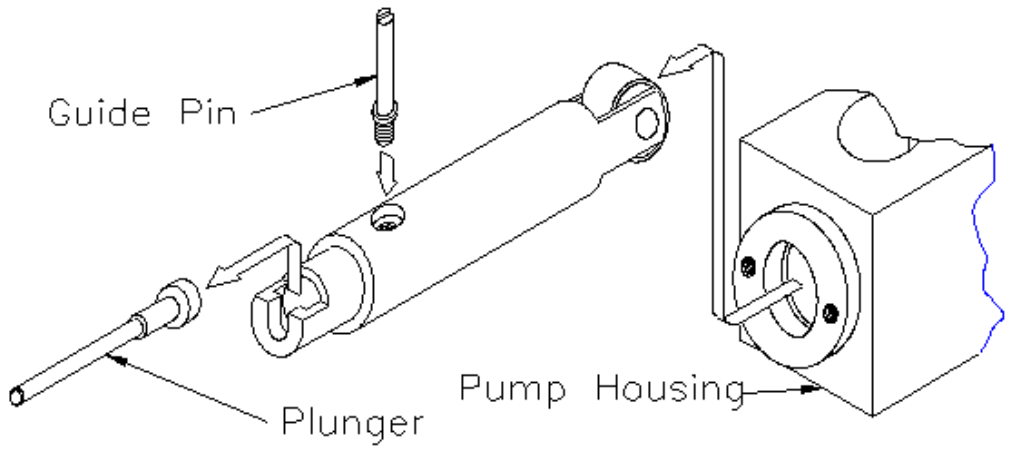
**Conditioning**

1) Prepare organic solvent such as iso-propanol or methanol necessary for training. In order to conditioning it, use organic solvent only and do not use buffer solution and base solution.

2) Mix iso-propanol or methanol by 50:50, and fill instrument with it using the prime/purge valve. And plug the outlet of pump.

3) Set the high pressure limit to 2000psi and make flow rate be 0.2ml/min at isocratic mode, and do not make air bubble be present inside using prime/purge valve again.

4) Start pump. The pressure will increase upto 2000psi and then the pump will be stopped with a high pressure limit message. Repeat this procedure 2-3times and then conditioning of seal is completed.




[**Fig 5.2.**] The replacement of the piston plunger

## 5.3 Replacement of piston plunger

If piston plunger is used for long time, it should be replaced due to wear.

The worn piston causes leakage of liquid as well as shortens life of high pressure seal. Piston wear is not well observed visually, so care should be taken when observing it.

1) Loosen tubing of inlet check valve and outlet check valve of pump head.

2) Press pump head to main body of instrument by hand, and loosen head nut.

3) Separate pump head assembly from instrument. Then, screen and plunger are left in the place where pump head assembly is loosened. When loosening it, pull it carefully to the direction of pump head guide so that high pressure seal may not be damaged due to eccentricity.

4) Pull plunger, replace it with new one at same location, and insert it.

5) If there are contaminants on surface of plunger, remove contaminant by applying methanol on cloth without dust.

6) Arrange plunger in the manner that plunger may enter the center hole of loosened pump head assembly, and then press pump head by hand so that head may be pressed into body. When pressing it, press it carefully and take care so that pump head may be maintained vertical.

7) Tighten head nut with it pressed. Tighten it so that left and right sides may be same in turn, and tighten it until it may be tightened no more by hand while confirming tightening status finally.

## 5.4 Replacement and cleaning of check valve

If check valve is not well operated due to contamination, pressure change is severe during operation and pump does not operate properly. Many problems of check valve are caused by small impurity which interferes with operation of check valve. Therefore, if impurity is prevented from entering inside of pump head using mobile phase filter, malfunction of check valve is almost not caused. Most of problems can be solved by cleaning the check valve cartridge and the pump head inside.

1) Separate tubing connected to pump head.
2) Loosen inlet and outlet check valve housing of pump head using spanner.
3) Wash check valve cartridge in separated check valve housing for about 30 minutes using ultrasonic cleaner with 10% nitric acid solution.
4) Using pure water, rinse check valve cartridge to remove the nitric acid used for cleaning.
5) Assemble loosened check valve in the reverse order.

## 5.5 Replacement of low pressure seal

Wearing of the low pressure seal is caused when pump has been used for long time without using washing port. In order to prevent wear of low pressure seal, it is desired to use washing port, and it is more desirable in case of using buffer solution. Leakage of liquid due to wearing of the low pressure seal is caused between pump head and body.

1) Separate pump head with reference to 5.2.
2) Separate washer, and pull out low pressure seal assembly from pump head body with seal insertion/removal tool.
3) Replace low pressure seal attached to low pressure seal assembly with new one.
4) Assemble pump head in reverse order by referring to 5.2.

## 5.6 Cleaning of flow path within pump

In order to prevent occurrence of problem in instrument, remove impurity accumulated in instrument, and it is better to clean flow path when it is not used for long time. Clean inside of flow path in the following method, and be careful when treating strong acid and strong base.

1) Separate column inlet tubing connected to column.

2) Orient column inlet tubing toward waste bottle.

3) Set flow rate at 1ml/min.

4) If injector is installed, turn it to injection position.

5) Pump 100% iso-propanol through pump and injector for 10 minutes.

6) Pump distilled water filtered through pump and injector for 10 minutes.

7) Pump 10% nitric acid solution for 5 minutes.

8) Wash pump and injector with distilled water filtered for at least 10 minutes.

9) Pump 100% iso-propanol through pump and injector for 5 minutes.

Now, pump is prepared for use of mobile phase or for the period not being used for short time or long time. If pump is not used for long time or there is contamination in flow path due to use of impure solvent, it is desired to separate pump head assembly and wash it with ultrasonic cleaner. In order to wash pump head, separate pump head into parts in the same manner as seal change process of 5.2, wash it with ultrasonic cleaner, and assemble each part again. At this time, the high pressure seal is damaged, so replace it with new one.

## 5.7 Supply of lubricant

The Gradient Pump necessitates supply of proper lubricant into piston drive part for smooth operation of instrument. It is desired to use lubricant or low viscosity grease for piston carrier and pump housing and small amount of grease such as 630-AA for bearing of cam shaft and piston carrier. Care should be taken because pumping action is interfered with if lubricant is attached to surface of piston. Because shortening of pump life is caused where powder or dust is much generated, install instrument where surrounding environment is good.

## 5.8 Change of mobile phase filter and in-line filter

In case instrument is used for long time or mobile phase is bad, mobile phase filter and in-line filter is

blocked due to small particles contained in solvent. If filter is blocked, pressure within flow path of pump is largely reduced when solvent is sucked to generate air bubble, make flow rate reduced and make precision reduced ; so it is desired to check it periodically. Main cause of mobile phase filter blocking is growth of bacteria, and two causes to block inlet filter is growth of bacteria and use of solvent containing impurity. In order to prevent growth of bacteria, use at least 10-20% organic solvent or solvent containing growth depressing component. If pure water or soluble solution without interfering material is used, many bacteria will grow in mobile phase filter though it is replaced with fresh solution everyday. Therefore, use solvent of HPLC grade filtered well at all times for mobile phase. Blocking of in-line filter is caused by accumulation of small particles generated due to wear of high pressure seal by using of impure solvent and long use of instrument. In case mobile phase filter and in-line filter are contaminated, condition of filter may be improved by washing it by ultrasonic cleaner with 10% nitric acid solution for 30 minutes. If it is not improved by ultrasonic wave cleaning, replace it with new filter.

**Change and cleaning of mobile phase filter**

1) Separate mobile phase filter from tubing. As the surface of teflon tubing of mobile phase filter of insertion type is slippery, separate it with tubing held avoiding slippage using #1000 sand paper.

2) In case of performing ultrasonic wave cleaning, wash head part by ultrasonic cleaner with 10% nitric acid solution for 30 minutes, wash it again by ultrasonic cleaner with pure water for about 10 minutes, then dry it. In order to replace filter with new one, prepare new mobile phase filter of same size.

3) If washing has been completed, assemble filter to be replaced newly again. Hold teflon tubing using sand paper and insert mobile phase filter of insertion type with center adjusted into middle hole.

**Changing and cleaning of in-line filter**

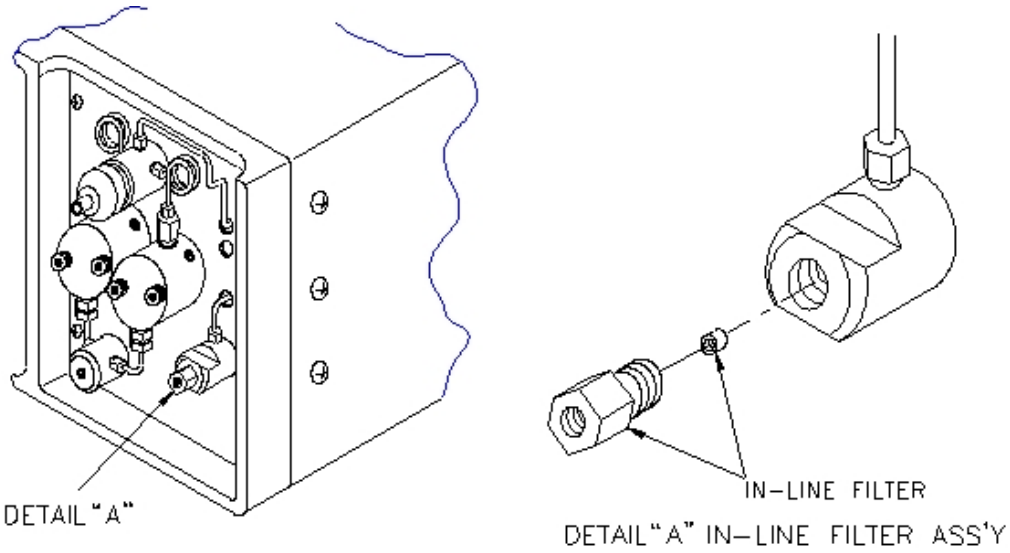
1) Separate connected tubing from in-line filter assembly using spanner.

2) Separate head part of in-line filter assembly from body using spanner.

3) In case of performing ultrasonic wave cleaning, perform ultrasonic wave cleaning to head part for 30 minutes with 10% nitric acid solution, perform ultrasonic wave cleaning for 10 minutes with pure water, and then dry it. In order to replace filter with new one, separate filter located at back side of head part.

4) In case of replacing it with new filter, replace it with new in-line filter located at the location where it was separated ; and in case ultrasonic wave cleaning has been completed, re-assemble head part of dried assembly.

5) Using spanner, tighten head part sufficiently so that there may be no leakage of liquid even at 6000 psi.




[**Fig 5.3.**] The replacement of the in-line filter.

## 5.9 Replacement of pulse damper

Diaphragm film of pulse damper may be damaged due to over-pressure.
Blue solution is discharged into outlet of pump in case diaphragm film is damaged, so that damper should be replaced. In order to replace damper, separate power code of instrument and remove cover. Because high voltage is maintained within instrument, power source of system should be off.

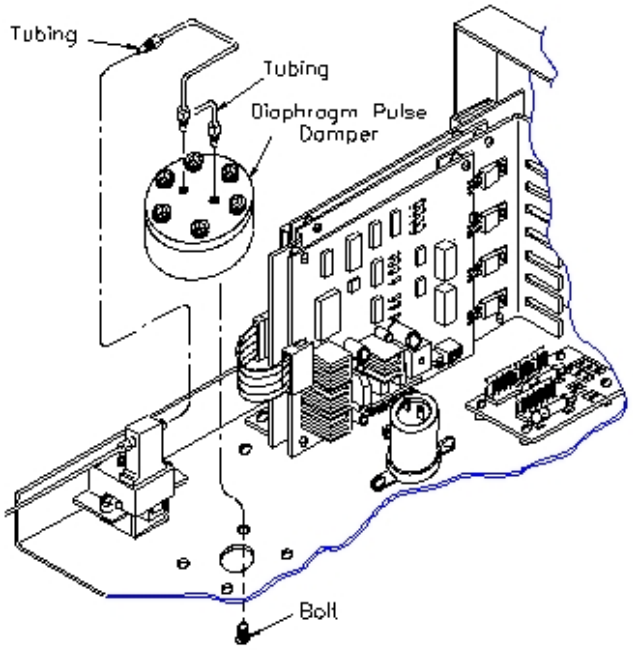
1) Power source of system should be certainly off. Pull out power code and remove cover.

2) Separate tubing from pulse damper using spanner.

3) Loosen 4 nuts which fixes pulse damper located at bottom side of the Gradient Pump, and remove attached pulse damper.

4) Locate new pulse damper, and arrange it with 4 holes in bottom side of the Gradient Pump.

5) In order to fix pulse damper at proper location, tighten 4 nuts at bottom side of pump cabinet.




[**Fig 5.4.**] The replacement of the pulse damper.

## 5.10 Troubleshooting

In case general problem occurs as the following table, confirm the possible causes regarding this first, and then take proper countermeasures. The following table is countermeasure in case general problems occur.

Table 5.1. Problems, cause and fixing

| Problem | Cause | How to fix |
|---|---|---|
| Pressure upper limit is loaded. | -Tubing inside is blocked. | -Replace blocked tubing by loosening to be from tail side in turn. |
| | -Check valve is blocked. | -Replace outlet check valve. |
| | -Solvent is changed. | -Wait until solvent is completely changed. |
| Pressure increases or decreases. | -Change of solvent is incomplete. | -Wait until change is completely performed. |
| | | -Wait until pressure is stable. |
| Solvent is not flowed out | -Air bubble is in pump head. | -Perform prime/purge again. |
| | -Air separation status of solvent is bad. | -Take measures so that air separation condition of solvent may be good, and perform prime/purge again. |
| | -Check valve is not good. | -Wash or replace check valve. |
| | -Liquid containing oil flows into head part. | -Remove oil in head sufficiently with strong organic solvent using prime/purge port. |
| Pressure is unstable. | -Check valve is bad or defected. | -Wash or replace check valve. |
| | -Air separation or mixing conditions of solvent is bad. | -Use mobile phase with well mixed solvent, and improve air separation condition. |
| | -Compression compensating reference value of configuration mode is wrong. | -Initialize compensation value or re-input proper value. |
| | -Cam shaft is loosened. | -Tighten wrench bolt of cam shaft |
| | -High pressure seal was worn. | -Replace high pressure seal. |
| | -Pump head was loosened. | -Tighten nut of pump head. |

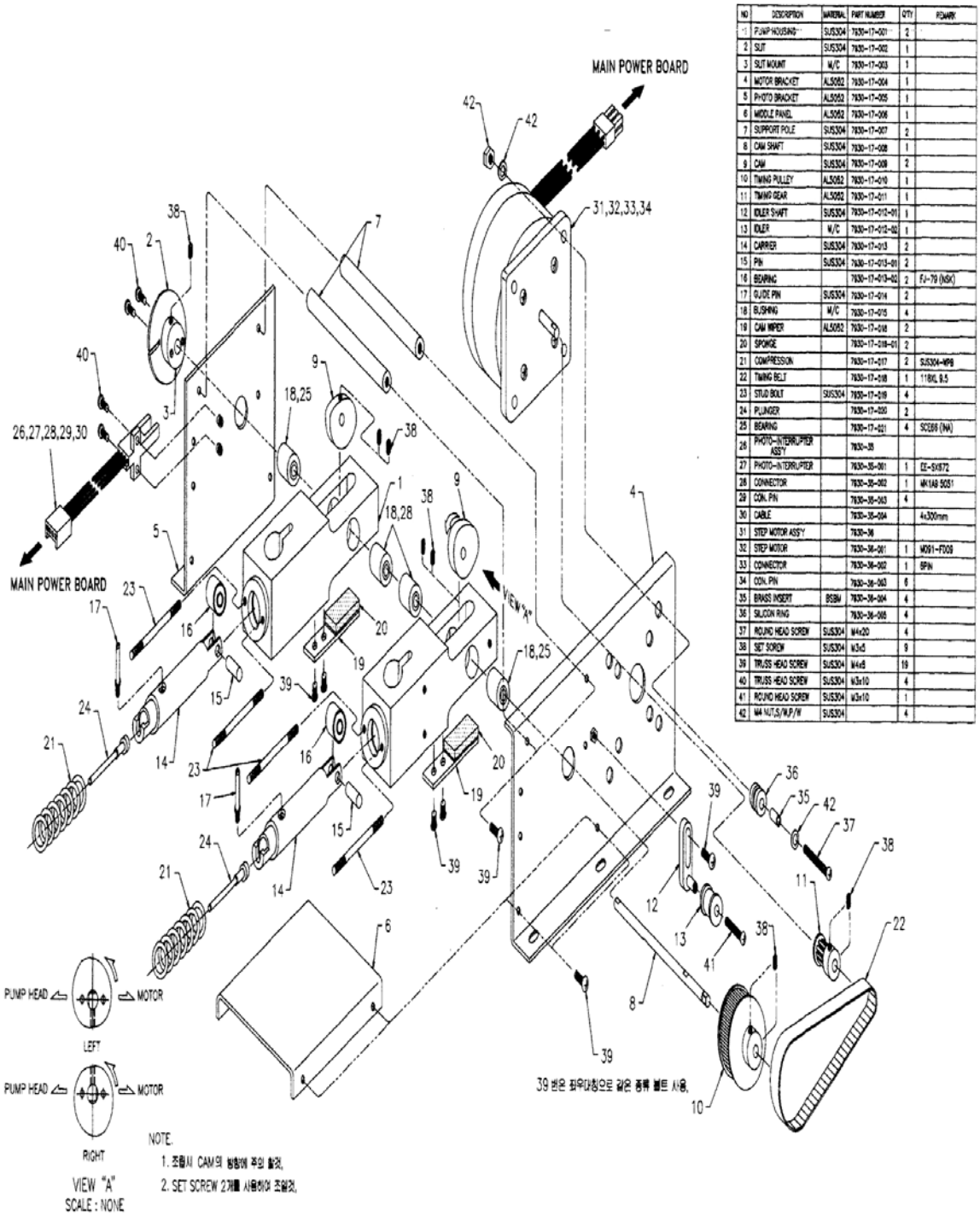
| Problem | Cause | How to fix |
|---|---|---|
| Liquid is leaked or pressure reduces when cleaning port is not used | -High pressure seal was worn.<br>-Plunger was worn. | -Replace high pressure seal.<br>-Replace plunger. |
| Liquid is leaked from inside of instrument. | -Fitting in instrument was loosened.<br>-Damper was damaged.<br>-Low pressure seal was worn. | -Tighten fitting in instrument.<br>-Replace.<br>-Replace low pressure seal. |
| Pump is not operated after input of power. | -Power voltage is unstable or low.<br>-Strong induction voltage is generated in the surroundings. | -Use stable, proper DC power source.<br>-Close induction power source in surroundings, or install instrument away from power source. |
| Noise is too high | -Load is caused to piston carrier.<br>-Timing belt is loose.<br>-Motor is in defect. | -Supply lubricant in carrier body.<br>-Reduce clearance above belt by adjusting guide location of timing belt.<br>-Inspect connection status of motor cable, and replace motor if noise is severe only in high pressure. |

## 5.11 Number and name of major parts

We at Younglin Instruments have major components of the Gradient Pump on-stock for product service 5 years after discontinuance. For the Gradient Pump which was sold, repair guarantee will be provided at no additional cost in case trouble occurs within 1 year under normal use. However, the following parts and cases are excluded.

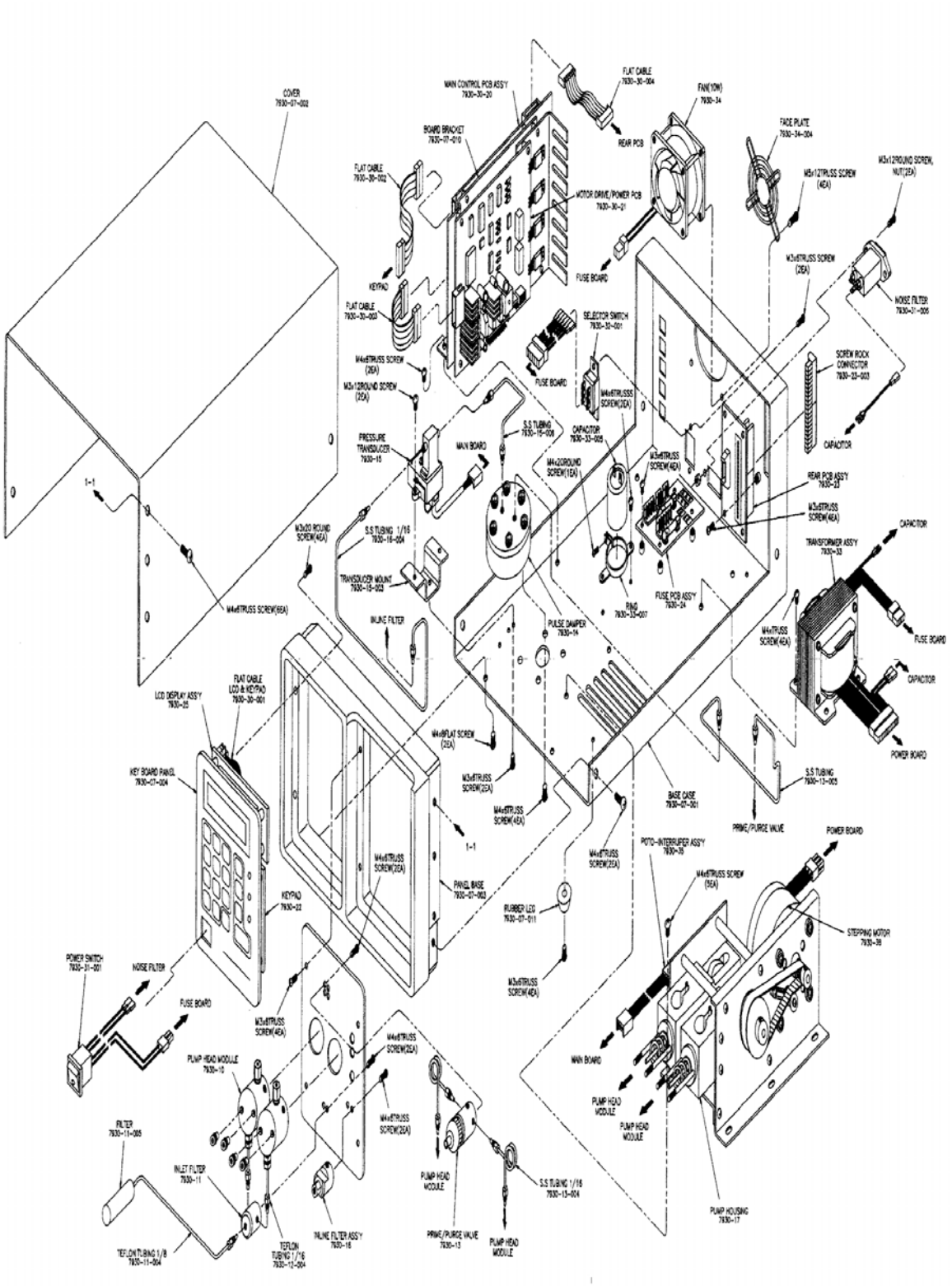
1) Consumable components such as ferrule, nut, filter, seal, etc.
2) Damage to instrument due to default of user.
3) Damage to instrument due to natural disaster, fire, etc.

| Part Number | Description | Remark |
|---|---|---|
| **Gradient Pump** | | |
| 1001012020 | Analytical Carrier Assembly | |
| 1601123010 | Pulse Damper Assembly | |
| 1001633430 | Timing Belt | |
| 1602423150 | In-line Filter Assembly | |
| 1602423130 | Prime purge valve | |
| 1602423270 | Zirconium Plunger (Analytical) | |
| 1602424030 | Outlet Check Valve Cartridge | |
| 1601823310 | High Pressure Seal Kit | |
| 9311032000 | Gradient Pump Main Board Assembly | |
| 1301032000 | Gradient Pump Motor Power Board Assembly | |
| 1301032010 | Gradient Pump Transformer Assembly | |
| 9311032010 | Gradient Pump Terminal Board Assembly | |
| 1301032040 | Middle Board Assembly | |
| 9311333030 | Gradient Pump Keypad & Silk | |
| 1301533210 | LCD Module (20 x 2) | |
| 1301533160 | Cooling Fan (126LH) | |
| 1301032020 | Transducer and Cable Assembly | |
| 9311032020 | Rinse Pump and Cable Assembly | |
| 1301032050 | Photo Sensor Assembly | |
| 1602323160 | Stepping Motor | |




| NO | DESCRIPTION | MATERIAL | PART NUMBER | QTY | REMARK |
|---|---|---|---|---|---|
| 1 | PUMP HOUSING | SUS304 | 7930-17-001 | 2 | |
| 2 | SUT | SUS304 | 7930-17-002 | 1 | |
| 3 | SUT MOUNT | M/C | 7930-17-003 | 1 | |
| 4 | MOTOR BRACKET | AL5052 | 7930-17-004 | 1 | |
| 5 | PHOTO BRACKET | AL5052 | 7930-17-005 | 1 | |
| 6 | MIDDLE PANEL | AL5052 | 7930-17-006 | 1 | |
| 7 | SUPPORT POLE | SUS304 | 7930-17-007 | 2 | |
| 8 | CAM SHAFT | SUS304 | 7930-17-008 | 1 | |
| 9 | CAM | SUS304 | 7930-17-009 | 2 | |
| 10 | TIMING PULLEY | AL5052 | 7930-17-010 | 1 | |
| 11 | TIMING GEAR | AL5052 | 7930-17-011 | 1 | |
| 12 | IDLER SHAFT | SUS304 | 7930-17-012-01 | 1 | |
| 13 | IDLER | M/C | 7930-17-012-02 | 1 | |
| 14 | CARRIER | SUS304 | 7930-17-013 | 2 | |
| 15 | PIN | SUS304 | 7930-17-013-01 | 2 | |
| 16 | BEARING | | 7930-17-013-02 | 2 | FJ-79 (NSK) |
| 17 | GUIDE PIN | SUS304 | 7930-17-014 | 2 | |
| 18 | BUSHING | M/C | 7930-17-015 | 4 | |
| 19 | CAM WIPER | AL5052 | 7930-17-016 | 2 | |
| 20 | SPONGE | | 7930-17-016-01 | 2 | |
| 21 | COMPRESSION | | 7930-17-017 | 2 | SUS304-WP8 |
| 22 | TIMING BELT | | 7930-17-018 | 1 | 118XL 9.5 |
| 23 | STUD BOLT | SUS304 | 7930-17-019 | 4 | |
| 24 | PLUNGER | | 7930-17-020 | 2 | |
| 25 | BEARING | | 7930-17-021 | 4 | SC08 (NA) |
| 26 | PHOTO-INTERRUPTER ASSY | | 7930-35 | | |
| 27 | PHOTO-INTERRUPTER | | 7930-35-001 | 1 | EE-SX872 |
| 28 | CONNECTOR | | 7930-35-002 | 1 | MK1AB 5051 |
| 29 | CON. PIN | | 7930-35-003 | 4 | |
| 30 | CABLE | | 7930-35-004 | | 4x300mm |
| 31 | STEP MOTOR ASSY | | 7930-36 | | |
| 32 | STEP MOTOR | | 7930-36-001 | 1 | M091-FD08 |
| 33 | CONNECTOR | | 7930-36-002 | 1 | 6PIN |
| 34 | CON. PIN | | 7930-36-003 | 6 | |
| 35 | BRASS INSERT | BSBM | 7930-36-004 | 4 | |
| 36 | SILICON RING | | 7930-36-005 | 4 | |
| 37 | ROUND HEAD SCREW | SUS304 | M4x20 | 4 | |
| 38 | SET SCREW | SUS304 | M3x5 | 9 | |
| 39 | TRUSS HEAD SCREW | SUS304 | M4x6 | 19 | |
| 40 | TRUSS HEAD SCREW | SUS304 | M3x10 | 4 | |
| 41 | ROUND HEAD SCREW | SUS304 | M3x10 | 1 | |
| 42 | M4 NUT,S/W,P/W | SUS304 | | 4 | |

[**Fig 5.5.**] The drawing of the Gradient Pump carrier housing




[**Fig 5.6.**] The drawing of the Gradient Pump

# UV/Vis Detector

## User Manual

YOUNG LIN INSTRUMENT

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# 1. Introduction

The Young Lin UV/Vis Detector is a dual wavelength ultraviolet/visible absorbance detector for HPLC. The detector is capable of performing applications from capillary to preparative scale, making it unmatched by any other detector in its class.

This manual describes the installation, operation, troubleshooting, maintenance and service for the UV/Vis Detector. The manual is organized in the following manner;

Section 1: This section briefly describes the capabilities and specifications of the unit.
Section 2: This describes the procedure for unpacking and installation of the instrument, and for routine operation as an LC detector.
Section 3: This described operation.
Section 4: This section describes routine maintenance and service.
Section 5: This section is a troubleshooting guide.
Section 6: This section describes the theory of operation.

## 1.1. Functions

The UV/Vis Detector is the most sensitive and versatile absorbance detector available for HPLC. It features dual wavelength capability, improved signal-to-noise performance, minimized drift and reduced optical bandwidth. The UV/Vis Detector is designed to provide higher performance in UV/VIS detection for HPLC application. With easy programmable front panel keypad and dual wavelength, the UV/Vis Detector will improve the productivity of any chromatography laboratory.

**Improved Feature and Design**

• Greatly reduced and compensated RI effect makes to minimize noise and interference of solvent peak
• Improved baseline stability with heat exchange effect

• Minimized drift by heat balance
• Easy access to lamp, cell as prealigned on the front panel
• Czerny-Turner Mount
• Split-beam Optics
• See Through Light Source
• Cone type flow cell

**Improved Capabilities**

Dual wavelength mode simultaneously monitors absorbance at two user selectable wavelength. It allows you to get more productive and additional analyte information by using Max, Min, Add, Diff and Ratio Plot modes. The UV/Vis Detector allows for optimized performance for analytical, semi-preparative and microbore whether you work in R&D, Analytical research or QA/QC.

**1. Wavelength Range** : 190 ~ 900 nm

1) 2 lamps used(Halogen and deuterium)

2) 2 filters used for removal of 2nd light

3) Self wavelength correction

**2. Operation Mode**

1) Single and Dual Wavelength Mode

- Enhanced selectivity, purity check

- Calculation : Max, Add, Diff, Ratio

2) Programmable Mode

- Automatic repetition

- 20 files and 40 lines

- Dual wavelength

3) Scanning Mode

- Blank scan

- Max, Add, Diff, Ratio Plot between each spectrum

4) Remote Control Mode

- via RS-232 control and data acquisition

**3. External Solenoid Valve and Switch(option)**

1) used for sample preparation

2) recycling for solvent

**4. Digitally controlled and operated**

1) High speed wavelength scanning

2) High resolution AD-DA

3) Digital Bessel filter

**Variable programmable operation for better sample information**

• **Absorbance mode** : Absorbance range is selectable within 0.001-3,000 AUFS for detection from 190 nm to 900 nm. Two wavelength can be monitored simultaneously.

• **MaxPlot mode** : MaxPlot monitors absorbance at two selected wavelengths and plots the maximum absorbance value for each sample components. This feature lets you maximize sensitivity even when exact

retention times of specific components unknown within a single spectrum run.

• **RatioPlot mode** : RatioPlot divides absorbance at two selected wavelengths and plots the resulting ratiogram to help detect hidden components that may be present under individual peaks.

**Easy and convenient operation**

The intuitive front panel display allows for increased with the flexibility you need. From the keypad on the front panel, you can program such capabilities as dual wavelength operation, spectral scanning, storage and playback, time and event-based protocols, method storage and retrieval. Also accessible from the front panel is the prealigned lamp and cone type flow cell, for easy instrument maintenance.

## 1.2. Specifications

**Wavelength** : 190 ~ 900 nm
**Lamp** : 1,000 hr lift Deuterium and Tungsten lamp
**Spectral Bandwidth** : 5 nm
**Wavelength Accuracy** : ± 1 nm
**Wavelength Precision** : ± 0.1 nm
**Optics** : Czerny-Turner Mount(Blazed Holographic Grating, Split beam)
**Measurement Range** : 0.000 ~ 3.000 AUFS
**Baseline Noise** : $\pm 2.0 \times 10^{-5}$ AU at 254 nm
**Baseline Drift** : $\pm 2.0 \times 10^{-4}$ AU at 254 nm
**Linearity** : > 99.7% at 1.0 AU
**Display** : 20 lines x 20 characters
**Flow Cells Type**: Cone type

| | |
|---|---|
| **Pathlength** : | Analytical : 10 mm |
| | Narrow bore : 5mm |
| | Semi-prep : 2mm |
| **Cell volume** : | 10 ㎕ |
| **Cell pressure** : | Analytical <1,500 psi |
| | Narrow bore < 1,500 psi |
| | Semi-prep < 1,000 psi |
| **Flow path material** : | SUS316, Sapphire, PTFE |
| **Attenuation** : | 0.2x ~ 2000x |
| **Time constant** : | 0.2 ~ 9.9 sec |
| **Dimensions** : | 297 x 198 x 495 mm(W x H x D) |
| **Power requirements** : | 110/220 ±10% VAC. 50-60 Hz. |

[**Fig 1.1**] The Young Lin UV/Vis Detector

# 2. Installation

## 2.1. Unpacking

Carefully unpack the detector from the shipping container and inspect both the unit and packing for any signs of damage. If any damage is noted, contact the shipping company immediately. In addition to this manual, the shipping container contains a power cord, and any options which you ordered. Carefully check the packing list against the contents of the container. If anything is missing, check the packing materials carefully for the overlooked items. If items are missing, contact us or your local supplier. Place the detector on the bench where it will be used and familiarize yourself with the location and function of the controls and connections.

### 2.1.1. Requirements

In addition to the detector itself, you will need the following items for setup and initial operation :
Autochro-2000(or Autochro-3000) Chromatography Data System.

1) HPLC
2) Column.
3) Standard test mix.
4) Appropriate solvents, reagents, etc.
5) Nuts, ferrules, appropriate to the column end-fittings being used.
6) Wrenches appropriate to column end-fittings.
7) Connecting tubing and union (if column cannot be connected directly to the cell).

## 2.2 Site requirement of the UV/Vis Detector

1) Room with 20℃ temperature with variation ± 5℃ with and 60% humidity
2) Where no direct and straight sunlight
3) Plain floor without carpet

4) Where having spare space of 20cm or more
5) Where there are 10% or less voltage change, no frequency change and 100Ω or less grounding point
6) Where there is no generation of corrosive gas and ventilation is well done
7) Where stable power of 110 or 220V is supplied
8) Where not receiving electromagnetic induction from large transformer, high frequency heater, UPS, etc.

### 2.2.1. Location

Place the detector on a laboratory benchtop in close proximity to the HPLC column outlet. Allow at least 5 inches of clear space between the rear panel of the unit and any wall or obstruction. This provides both access to the rear panel connections and a free flow of air

## 2.3. Connections and control

### 2.3.1 Connections for power

There are a power input, a voltage selection switch and a fuse holder on the rear panel of the UV/Vis Detector. The fuse is 0.6A for 220V and 1.2A for 110V. Please be careful to note the voltage which is setup at our factory before turning on. Normally 220V is setup for exporting detectors.

### 2.3.2. Fluid Connections

The Detector fluid inlet is the short tube which comes from the front of the UV/Vis Detector. As a general rule, the less tubing between the column outlet and the flow cell, the better. Ideally, the column outlet should be connected directly to the detector inlet line. If this is not possible, you should use a minimum length of narrow bore (0.010 inch I.D.) connecting tubing and a zero dead volume union. Because different columns use different fittings, the detector is supplied with a bare tube end to allow connection to any column accepting 1/16 inch O.D. tubing. You should use nuts and ferrules suitable to your column.

**NOTE: Tubing size and position is different for the adjustable pathlength preparative flow cells, high pressure microbore flow cell, off column capillary flow cell, and on column capillary flow cell. See their owner's manuals for details.**

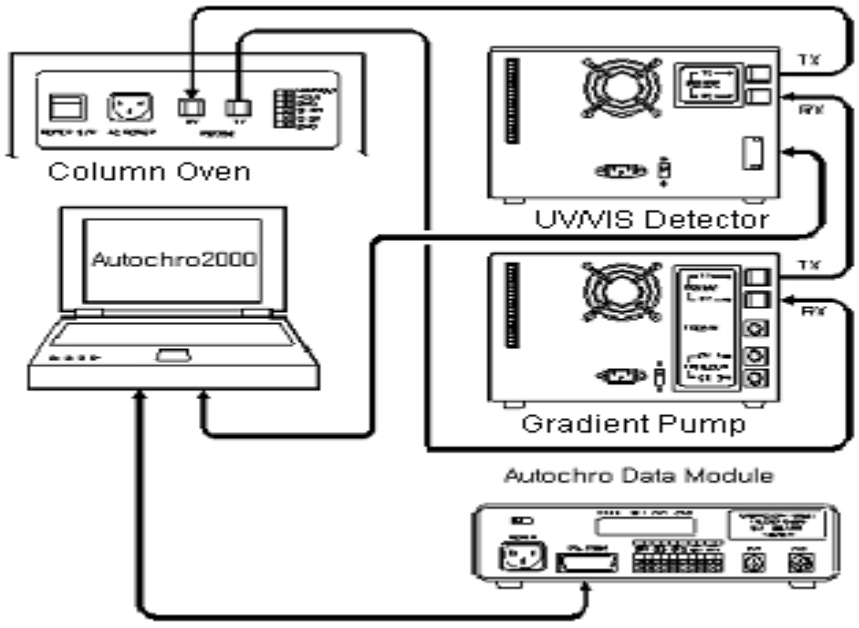
Connect the cell outlet to a line leading to an appropriate waste reservoir. If bubble formation in the detector cell causes problems, you may wish to connect the cell outlet to a restrictor or back pressure device providing 20-60 psi back-pressure.

**NOTE: Before connecting any new tube or column to the detector, flow several mL of clean solvent through the new tube to a waste reservoir. This will clean any particulates or oil that may be residing in the tube that could clog the heat exchanger or contaminate the sample cell of the detector.**

### 2.3.3 Connections for cable

The UV/Vis Detector can be controlled by RS-232C and also be controlled and acquired digitally by Autochro-2000(or Autochro-3000) via RS-232C. For communication using RS-232C connection, use the RX and TX loop connection as shown in the Fig 2.1.

At first, connect the RS232C cable between PC and UV/Vis detector, and then RX/TX loop connection between each module. If you want to use AD module, have to connect RS232C cable between PC and AD module for communication. And then connect signal and remote cable between UV/Vis detector and AD module.




[**Fig 2.1**] The RS-232C connection of the UV/Vis Detector with the Gradient Pump

## 2.3.4 The connection of the terminals

You can designate input signal recognition of terminals on the Setup Edit mode. The UV/Vis Detector recognizes the input signal on the point of TTL level(0 ~ 5V) and Trigger rising and falling edge of the terminals. Each terminal function is described as per default values as follows. Be careful about polarity to connect cables.

**START** : starts a time program or data acquisition by remote operation with Autochro-2000.
**STOP** : stops a time program or data acquisition by remote operation with Autochro-2000.
**LAMP** : turns on a lamp when terminal is short. When short is released, a lamp is turned off.
**MK-IN** : notes marker input during a time program.
**A.ZERO**: executes auto-zero of absorbance.
**CHART**: outputs 50% marker input of full scale for 0.1 second.

Terminal connections are explained as follows. If SW1 and SW2 are connected to GND and TTL is connected to +12V, the UV/Vis Detector outputs the current maximum upto 0.5A for solenoid valve operation.

**CH A 1.0V** : outputs 1.0V for full scale(1.0 AU) on the channel A.
**CH A 10mV** : outputs 10mV for full scale(1.0 AU) on the channel A.
**CH B 1.0V** : outputs 1.0V for full scale(1.0 AU) on the channel B.
**CH B 10mV** : outputs 10mV for full scale(1.0 AU) on the channel B.
**HOLD** : outputs ready status of the Detector as TTL voltage. However If the UV/Vis Detector is not ready to receive the START input, outputs TTL HIGH.
**MK-OUT** : If press the START key or designate the marker output, outputs TT L HIGH for 200ms.

[**Table 1.1**] Terminals and their outputs

| No. | Input | Output |
|---|---|---|
| 1 | START (+) | CH A ±1V |
| 2 | START (-) | CH A ±10mV |
| 3 | STOP (+) | CH A GND |
| 4 | GND | CH B ±1V |
| 5 | Lamp Off(+) | CH B ±10mV |
| 6 | GND | CH B GND |
| 7 | Mark-in(+) | Hold |
| 8 | GND | Mark-out |
| 9 | Autozero(+) | GND |
| 10 | GND | SW1 |
| 11 | Chart Mark(+) | SW2 |
| 12 | GND | +12V |

# 3. Operation

## 3.1 Keyboard operation

### 3.1.1 Keys for run mode

[**Fig 3.1**] Keyboard of the UV/Vis Detector

Press any of following keys for run mode and press the CLEAR/SCROLL key and select Yes and press the ENTER, then you can select new run mode.

**SINGLE/DUAL** : selects single or dual wavelength. If you press the key sequentially, selection for single or dual wavelength is displayed accordingly.
**TIME RUN** : runs wavelength and time constant to be set for the UV/Vis Detector according to a time program.
**SCAN** : scans wavelength range which is set and get absorbance spectrum.
**REMOTE** : used for control of the UV/Vis Detector by external communication.

### 3.1.2 Keys for edit mode

**MENU** : used for change run conditions during run mode.

**PROGRAM** : used for creating a time program for TIME RUN mode.

**SETUP** : used for changing setup values for normal status.

**CONFIG** : used for changing configuration values for the UV/Vis Detector.

**<START/STOP>**

used for start and stop of a program during program run mode and for scanning during scan mode. One press for start and one more press for stop.

**<Number key : 0~9, •, - >**

used for input of numbers during edit mode(cursor is displayed).

**<CLR/SCR>**

used for clear display during edit mode and for changing next selection. Also shows next display when a cursor is no there.

**<▲,▼>**

used for moving next display during edit mode or display status.

### 3.1.3 Keys for operation

When the UV/Vis Detector is on display status, press the following keys to run their functions immediately.

**Contrast** : adjusts the contrast of LCD display. After adjust brightness by the key ▲and ▼, press the Contrast key to return.

```
< LCD Contrast : 5 >
++++++++++++++++++++
```

**Auto Zero** : automatically change current absorbance to zero.

**Chart Mark** : outputs 50% chart market of full scale for 0.2 seconds to D/A output.

## 3.2 Self diagnostics

After turning on, the UV/Vis Detector checks stored data and power, then self-wavelength correction. The function of self-wavelength correction assures accuracy and precision of wavelength. When any of fatal errors are occurred, operation of the UV/Vis Detector is terminated. If errors are not fatal, the errors will be displayed.

## 3.3 Internal data processing

You can get various data output according to setting of Channel A and B.

◇ **Time Constant** : used for the digital filer. If value is larger, the baseline is smoother while peak width is wider.

◇ **Sensitivity** : outputs after dividing by this value( 0.1 means 10x ).

◇ **Offset** : outputs after adding this value.

◇ **Polarity** : outputs by negative or positive.

◇ **Plot** : outputs after applying various plot calculation.

⇒ Calculation between channel ;

(A : the absorbance of channel A, B : the absorbance of channel B)

If A and B are designated as above, each setting output for channel A and B is outputted as shown in the Table 3.1. Specially, Ratio output can be used for dual wavelength mode and for finding hidden peak over large peak.

[**Table 3.1**] Various output setting for Channel A and B

| | **Channel A** | **Channel B** |
|---|---|---|
| Max | Higher value between A and B | |
| Add | A+B | |
| Diff | A-B | B-A |
| Ratio | A/B | B/A |

## 3.4 Single and dual wavelength mode

Press the SINGLE/DUAL key and use the CLEAR/SCROLL key until Yes is displayed, then press the Enter key to select anyone of Single or Dual.

| (SINGLE) ◀A▶ 254nm |
|---|
| Absorbance: -0.00001 |

On the upper line, mode, channel and wavelength are displayed and using the CLEAR/SCROLL key changes the mode from Single to Dual or vice versa. On the lower line, you can see the following data for selected mode and channel by using the key of ▲and ▼.

**Absorbance** : absorbance
**Transmittance** : transmittance
**Output** : output voltage of terminal
**Sample Energy** : light energy of sample cell
**Ref. Energy** : light energy of reference cell
**Time Constant** : time constant
**Sensitivity** : output sensitivity of terminal full scale
**Plot** : output settings such as Max, Add, Diff, Ratio
**Lamp** : used time of a deuterium lamp and a tungsten lamp.
**Run Time** : elapsed time after input of the START/STOP key.

On the above display, press the Menu key and change the values if you want to select wavelength, time constant, sensitivity, output and etc. The wavelength for the Single wavelength mode uses the wavelength of the channel A(☞ **MENU Edit**). On the Dual wavelength mode, you can select two wavelengths for channel A and B simultaneously and use for the absorbance for two wavelengths and calculations between two wavelengths.

## 3.5 Time program mode

Press the TIME RUN key and select Yes by using the CLEAR/SCROLL key and then press the ENTER key. Following is displayed and the Single/Dual wavelength mode is executed. For execution of the Time program mode, load the file number, you want to run, which is created in the Program edit mode. Also, you can limit maximum chain count or external trigger by input of the value. If you press the • key, you can re-input the value again and edit the file number which is in use. However the edited file is applied after a new run.

| Time Event Run<br>Mode select ? Yes | Time Event Run<br>Load File : 1 ~ 20 |
|---|---|
| Load File Number: 11<br>Max.Chain Count : 999 | F# ID MD Chain Time<br>11 0 SG 999 Stop |

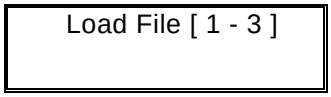
- **File Number** : 1 ~ 20 (the number of a program)
- **Max. Chain Count** : 1 ~ 999(for use of the execution numbers of the trigger START input or the event start)

On the above display, pressure of the CLEAR/SCROLL key, followings are displayed. Then press the ▲or the ▼key to see transmittance, light intensity or output data.

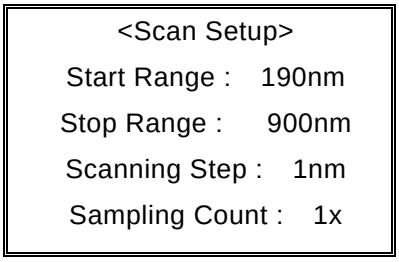
| TIMERUN】◀A▶254nm<br>Absorbance: 0.00000 | 【TIMERUN】◀B▶254nm<br>Absorbance: 0.00000 |
|---|---|

## 3.6 Wavelength Scan mode

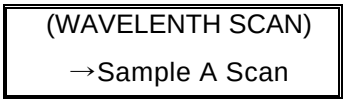
The scan mode is used for getting absorbance spectrum from a sample. From the absorbance spectrum, you can get information for maximum absorbance wavelength. After selection of the scan mode, input the file number that you want to use.

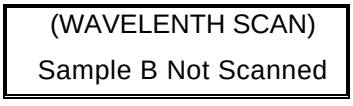



After select the file number, input the values for wavelength range, scanning step, and sampling count. You can get better spectrum if you select less scanning step and more sampling count but scan rate is slowed.




After finished the values input, select blank, sample A and B by using the ▲and the ▼key.




On the above screen, press the START/STOP key to start scanning. One time pressure to pause and press one more time to re-start. If you press two times consequently, the UV/Vis Detector cancel scanning.

| >Sample B Scan→PAUSE |
|---|

After scanning is finished, press the ENTER key to display scanning result. Press the ▲or the ▼key to move wavelength and see absorbance for the wavelength by using the CLEAR/SCROLL key. If you want to the sample again, press the ENTER key or the START/STOP key. On the following display, you can see the absorbance and sign to confirm maximum height and size of a peak.

| WL | ABS | Sign |
|---|---|---|
| 220 | -0.00001 | >>>> |

| WL | %T | Output |
|---|---|---|
| 220 | -100.0 | -1000.0 |

If you want to scan again, press the • key.

## 3.7 Menu settings

The MENU key is used for channels settings, lamps on/off and variables for external switches.

**CH A** : setting for the channel A
**CH B** : setting for the channel B
**Switch1**: setting for the switch 1
**Switch2**: setting for the switch 2
**Lamp** : Tungsten or deuterium lamp's on/off
**Key lock** : Locking keys

| >Select Menu (1-6)<br>1:Channel A setting |
|---|

| |
|---|
| 1:Channel A setting |
| 2:Channel B setting |
| 3:Switch 1 setting |
| 4:Switch 2 setting |
| 5:Lamp On/Off |

Press the MENU key and select the number by using the ▲or the ▼key and pressure the ENTER key or press the number key that you want to set directly. Then you can enter the setting values. If you press the MENU key again, previous status is displayed.

### 3.7.1 Setting for channel A, B (selects the number key of 1 or 2)

| | |
|---|---|
| <Channel A> | 1/6 |
| Wavelength : | 254nm |

| |
|---|
| Wavelength : 254nm |
| Sensitivity:1.0000FS |
| Time Constant:1.0sec |
| Offset: 0.0 mV |
| Polarity: Positive |
| Plot: Absorbance |

**Wavelength** : select the wavelength for each channel. The channel B uses the wavelength for the channel A in the single mode.

**Time constant** : enter from 0.1 to 9.9 sec.

**Sensitivity** : outputs analog voltage by converting the set values to maximum scale after divided by the set value.

**Offset** : sets offset for analog output.

**Polarity** : sets polarity for analog output.

**Plot** : sets for analog output

### 3.7.2 Setting for external switch 1 and 2(selects the number key of 3 or 4)

| <Switch 1> | 1/7 |
|---|---|
| Channel Set : | A |
| Threshold: 0.0001Abs | |
| Peak Width: | 10 sec |
| Output: | On |
| Pulse Width: 1.00sec | |
| Start Delay: | 0.1sec |
| Stop Delay : | 9.9sec |

**Channel Set** : sets the channel for the external output switch.
**Threshold** : enters the threshold for the switch working by absorbance variance.
**Peak Width** : sets the second for the switch working time.
**Output** : sets the switch status(on or off) when absorbance variance is over the threshold.
**Pulse Width** : sets the pulse width when the switch working is set as pulse.
**Start Delay** : sets the second for start delay time of the switch working when absorbance variance is over the threshold.
**Stop Delay** : sets the second for stop delay time of the switch working when absorbance variance is less the threshold.

### 3.7.3 Lamp setting (selects the 5 key)

Turns a lamp on or off. A deuterium lamp is on 3 seconds after set to ON for warming up.

| <Lamp control> | 1/2 |
|---|---|
| Deuterium Lamp : | On |
| Halogen Lamp : | On |

**Deuterium Lamp** : On / Off
**Halogen Lamp** : On / Off

### 3.7.4 Key Lock

Works immediately after selection and the character shaped a key is lightening on/off on the upper right of the LCD during locking. All keys except the ▲, the ▼or the CLR/SCR do not work. For unlocking, press • **7 3 0** • sequentially.

## 3.8 Execution of Remote mode

If you select the remote mode, you can use most of the UV/Vis Detector's functions. The mode should be selected when you control the UV/Vis Detector by Autochro-2000 or Autochro-3000 control program. On the LCD, elapsed time during the remote mode is displayed.

## 3.9 Time event program mode

| |
|---|
| <TIME EVENT PROGRAM> |
| Load File Number: |

| |
|---|
| Clear File ? No |
| Initial Event ? No |

In the time event program mode, you can edit file numbers from 1 to 20 which have maximum 40 lines. The status worked by a time event program is maintained after the program is finished. If you select Yes on Initial event, you can set new value for all initial event values. If select No, previous initial event values are applied.

| | |
|---|---|
| <Initial Ch A> 1/6 | <Initial Ch B> 1/6 |
| Wavelength: 254 nm | Wavelength: 254 nm |
| Sensitivity:0.0001FS | Sensitivity:0.0001FS |
| Time Constant:9.9sec | Time Constant:9.9sec |
| Offset: 0.00 mV | Offset: 0.00 mV |
| Polarity : Positive | Polarity : Positive |
| Plot: Log Absorbance | Plot: Log Absorbance |

| <Initial Sw 1> 1/7 | <Initial Sw 2> 1/7 |
|---|---|
| Channel Set : A | Channel Set : A |
| Threshold : 0.0001AU | Threshold : 0.0001AU |
| Peak Width : 10 sec | Peak Width : 10 sec |
| Output: On | Output: On |
| Pulse width: 1.0 sec | Pulse width: 1.0 sec |
| Start Delay: 0.1 sec | Start Delay: 0.1 sec |
| Stop Delay : 0.1 sec | Stop Delay : 0.1 sec |

After finish entering initial event values, following displays are appeared.

| Event | Action |
|---|---|
| Chart Mark | - |
| ID Time | Select |
| 00 Init | Function |
| Mark-in | |
| N/A | |

Edit a time event program as following instructions.

**Add a line** : enter new time, then * is displayed on the ID and select. After all entering are finished, a line is added. Lines are arranged in the order of time.

**Delete a line** : When the cursor is on the ID, press the CLR/SCR key to delete a line. However the first line can not be deleted.

**Edit a line** : On the above display, press the ENTER key to edit a line. After finish editing the line, press the Enter key to close.

**Confirm a line** : Use the ▲or the ▼key to confirm lines, or the CLR/SCR to see another display.

Programmable events and their workings are described in the Table 3.2. When the Mark-In is set as “Wait”, the event is waiting for the marker input before works. If one more events are waiting for the marker input, the events work simultaneously when the marker is inputted.

[**Table 3.2**] Programmable events and their works

| ID | Time | Select | Event | Works | Mark-In |
|---|---|---|---|---|---|
| Max. 0 | 0 ~ 999.99 min | Function | WL A | Sets the wavelength for Channel A(nm) | Wait |
| | | | WL B | Sets the wavelength for Channel B(nm) | |
| | | | Mode | Single, Dual | |
| | | | Mark-out | On, Off, Pulse | |
| | | | Autozero | - | |
| | | | Chart Mark | - | |
| | | | D Lamp | On, Off | |
| | | | W Lamp | On, Off | |
| | | | New File # | 0 ~ 20 (# : file name) | |
| | | | Event | Init, Start, Stop | |
| | | Channel A Channel B | Sensitivity | 0.0001 ~ 5 FS (sets the sensitivity. The output is divided by the sensitivity value. | |
| | | | Time constant | 0.1 ~ 9.9 sec (response time of signal) | |
| | | | Polarity | Positive, Negative | |
| | | | Plot | Abs, Log Abs, Transmit, Sam E, Ref E | |
| | | Switch 1 Switch 2 | CH Set | A, B, A&B, None | |
| | | | Threshold | -1 ~ +1 [V] | |
| | | | PeakW | 1 ~ 99 [sec] | |
| | | | PulseW | 0 ~ 99.9 [sec] | |
| | | | DelayS | 0 ~ 99.9 [sec] | |
| | | | DelayP | 0 ~ 99.9 [sec] | |

## 3.10 Setup mode

The setup mode is used for setting the output of ratio calculation, the recognition of terminal input, filter type, second cut filter, autozero and chart marker.

| <Setup> 1/14 |
|---|
| Ratio Min. AU: 0.001 |
| Ratio Maximum: 5.0 |
| Ratio Minimum: 0.1 |
| AZ on Start : Yes |
| AZ on WL change :Yes |
| CMK on Start : No |
| Ext Auto Zero : Low |
| Ext Chart Mark: Low |
| Ext Start : Low |
| Ext Stop : Low |

**Ratio Minimum AU**: enter minimum absorbance for ratio calculation output. If this minimum absorbance is not used for calculation, the terminal outputs 0 volt. Also, if two absorbances are all negative, the terminal outputs negative volt and if two absorbances are different in polarity, outputs 0 volt.

**Ratio Maximum** : enter maximum ratio value. This value is outputted as maximum volt.

**Ratio Minimum** : enter minimum ratio value. If the ratio is less than the value, the terminal outputs 0 volt.

**AZ on Start** : set autozero when starts a program, scan or any run mode.

**AZ on WL Change** : set autozero when change wavelength.

**CMK on Start** : set marker output when start a program, scan or any run mode.

**Ext Auto Zero** : set autozero by external terminal input.

**Ext Chart Mark** : set chart marker input by external terminal input.

**Ext Start** : set start when low or high point by external terminal input*.

**Ext Stop** : set stop when low or high point by external terminal input*.

**Ext Lamp Off** : set lamps' on/off by external terminal input.

**Filter Type** : set the type of a digital filter(Average, 1st RC or Bessel)

**Second Cut Filter** : set use with the second cut filter.

## 3.11 Configuration mode

| CONFIGURATION |
| --- |
| Password : *** |

Input password to enter the configuration mode by pressure of the CONFIG key. The default password is set as UV/Vis Detector at the factory. The password can be changed by pressure of the CLR/SCR key. If you forgot the password, ask us or your supplier.

| <Config> 1/12 |
| --- |
| Instrument ID : 1 |
| COM1 Set: 9600,n,8,1 |
| D2 Lamp Time: 0 |
| W Lamp Time: 0 |
| 2nd Filter1 WL: 220nm |
| 2nd Filter2 WL: 220nm |
| Maximum WL : 1100nm |
| Minimum WL : 190nm |
| CH A Calib.: 0 |
| CH B Calib.: 0 |
| Lamp Warming : 20sec |
| Pre-AMP Gain: 10 |

**Instrument ID**: set the ID used for communication between instruments. Same ID can not be used. ID of detector is 1.

**COM1 Set** : sets COM1 for communication between UV/Vis Detector. no parity, 0 data bit, 1 stop bit.

**D2 Lamp Time** : enter the used time of a D2 lamp. When replace with a new lamp, enter 0.

**W Lamp Time** : enter the used time of a W lamp. When replace with a new lamp, enter 0.

**2nd Filter1 WL** : set the wavelength of the 2nd filter for UV range.

**2nd Filter2 WL** : set the wavelength of the 2nd filter for VIS range.

**Max Wave** : set maximum wavelength. Can enter up to 1100nm.

**Min Wave** : set minimum wavelength. Can enter down to 190nm.

**Lamp Warming** : set pre-warming time for a deuterium lamp.

**CHA Calib** : set the counter value for voltage correction against 0.0V of channel A terminal.

**CHB Calib** : set the counter value for voltage correction against 0.0V of channel B terminal.

**Pre-AMP Gain** : set the gain for the pre-amp which is connected a light sensor.

# 4. Regular Maintenance and Service

## 4.1. Light sources

The UV/Vis Detector uses light sources: A deuterium ($D_2$) lamp assembly (190-600nm) and tungsten (W) lamp assembly (380-800nm). All lamp assemblies are supplied pre-aligned and no further alignment adjustment is required.

### 4.1.1 The deuterium lamp

The Deuterium Lamp ($D_2$) is rated for 1,000 hours of life to 1/2 the original intensity (this does not mean that the lamp will burn out after 1,000 hours, merely that its intensity will be reduced to 50% of the original output). A $D_2$ lamp using time is counted in the system indicating the total hours of operation.

To check the lamp intensity:

1) Power on the unit if it is not already on. Wait for a period of approximately 10 minutes.
2) Set the wavelength to 254 nm
3) Select the Reference Light Intensity.
4) If the displayed value is equal to or greater than 30, the lamp is good. If the displayed value is 1/2 the original intensity, the lamp is marginal. If the displayed value is less than 1/2 the original intensity, the new lamp should be prepared.

As a general rule, the $D_2$ lamp should produce reference light intensity greater than 30 at 254 nm.

### 4.1.2. To remove the $D_2$ lamp

1) Make sure that the power cord is disconnected from the rear panel of the detector.
2) Unscrew the screws and remove the lamp assembly on the right front panel.

**CAUTION** ; UV light can damage eyes and skin. Always disconnect the power cord before working in the vicinity of the lamp. The $D_2$ lamp gets quite hot. Care must be taken while handling it to prevent from burning. Always allow the lamp to cool before removing it.

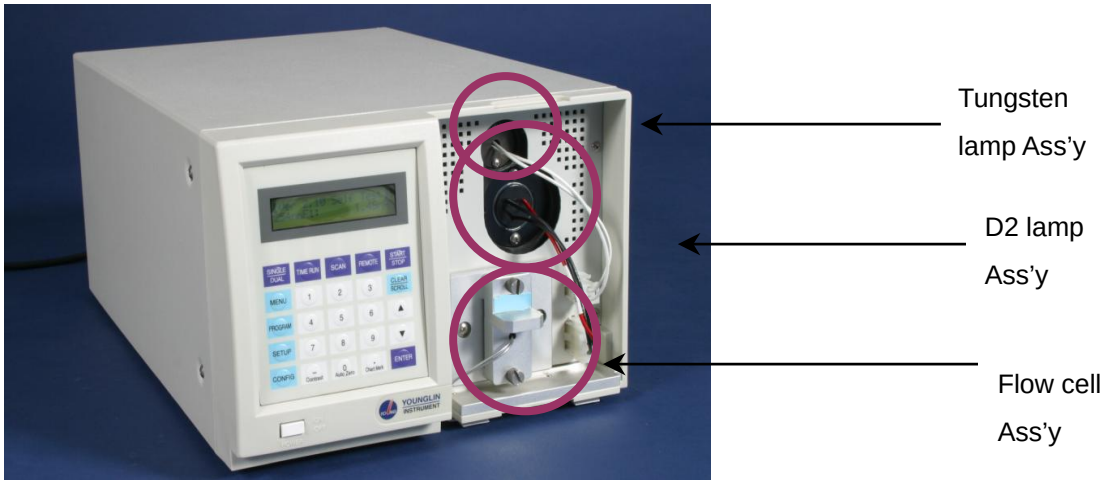
3) Disconnect the UV lamp from the detector by gently pulling it straight back toward you.
   DO NOT twist the connector while pulling (see <Figure 4.1> and <Figure 5.1>).
4) Unscrew the two thumbscrews holding the lamp mount in place, and pull the lamp mount straight back towards you. Be careful not to lose the two thumbscrews. Be careful not to get fingerprints on the lamp.

### 4.1.3 To install the $D_2$ lamp

1) Slide the lamp mount onto the lamp housing on the right front panel.
   (the mount has a pre-drilled hole to accommodate the dowel) (see <Figure 4.1> and <Figure 4.2>).
   The lamp leads should emerge from the top of the lamp.
2) Use the thumbscrews to attach the lamp assembly to the detector.
3) Connect the lamp lead to the lower of the two terminals in the lamp compartment.

**CAUTION** ; NEVER loosen the screw holding the lamp to the mount, and never attempt to rotate or move the lamp up or down in the mount. Doing so will degrade the system performance. The lamp is provided as a pre-aligned assembly.

**NOTE**: No harm will be done if the lamp is plugged into the wrong connector, but the lamp will fail to light.




[**Fig 4.1**] TFig 4.1 The front side of the UV/Vis Detector

[**Fig 4.2**] The deuterium lamp assembly

### 4.1.4 The Tungsten lamp(W)

The lifetime of the tungsten lamp is approximately 1,500 hours. To check the W lamp intensity:

1) Power on the unit and W lamp if it is not already on. Wait approximately 10 minutes.
2) Set the wavelength to 720nm.
3) Select the Reference Light Intensity.
4) If the displayed value is equal to or greater than 10nA, the lamp is good. If the displayed value is between 5 and 10, the lamp is marginal. If the displayed value is less than 5, the lamp should be replaced.

In general, a value less than 3 for the 380-450 nm range and less than 5 for 450-800 nm range is indicative of a bad W lamp. The W lamp should be used for all wavelengths above 380 nm. The user may notice higher relative light intensities for the D2 than the W lamp from 380-450 nm. However, this light represents the second order diffraction spectra of the D2 lamp and should not be used.

### 4.1.5 To replace the tungsten lamp

1) Make sure that the power cord is disconnected from the rear panel of the detector.
2) Unscrew the screw and remove the lamp housing (the rear housing on the left side of the detector) to expose the W lamp.
3) Disconnect the W lamp lead from the detector by gently pulling straight back toward you. Do not twist the connector while pulling.
4) Unscrew the thumbscrews holding the lamp assembly in place, and pull the lamp assembly straight back toward you. Be careful not to lose the aluminum standoffs or the thumbscrews. Be careful not to get fingerprints on the lamp.
5) Replace the lamp assembly.

[**Fig 4.3**] The tungsten lamp assembly

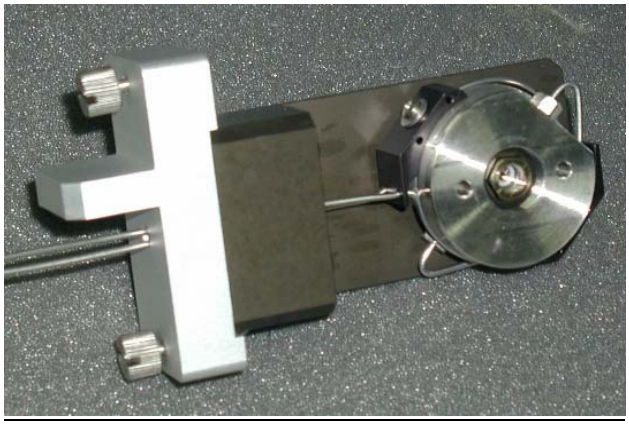
**WARNING** ;
The W lamp gets quite hot. Allow enough time to cool before attempting its removal.

## 4.2 Cleaning of the flow cell

If at all possible, we do not recommend disassembly of the flow cell assembly for routine cleaning purposes. Most cells can be adequately cleaned by flushing with several milliliters of appropriate solvent. We recommend the following solvents for this purpose:

1) Methanol
2) Tetrahydrofuran
3) Methylene Chloride
4) HPLC Grade Water
5) 6 N Nitric Acid followed by flushing with HPLC Grade Water

**NOTE** : Use only spectroscopic grade solvents.



[**Fig 4.4**] The Flow cell Assembly

# 5. Troubleshooting

Most "problems" with HPLC detectors are, in fact, caused by other parts of the system. Noisy and drifting baselines, poor reproducibility in quantitative analysis, and similar problems are more often the result of dissolved air bubbles, contaminated eluents, dirty samples, or damaged columns rather than of actual problems with detector hardware. In order to focus more effectively on troubleshooting detector problems, we will first discuss on-board diagnostic tips and later present a troubleshooting table organized by symptom, cause, remedy.

## 5.1. Light intensity diagnostics

The detector provides the capability of monitoring relative light intensities at both the sample and reference photodiodes. If an unusually noisy baseline is noted, relative intensities of reference and sample light should be assessed. Acceptable values are dependent upon the flow cell used, wavelength of operation, and background absorbance. The basic guidelines are as follows:

**NOTE**: This reference light value of 30 is only applicable for wavelengths within the acceptable range for a given lamp.

1) Sample light intensity is higher than 50% of reference light intensity if flow cell and lamp are normal condition.
2) If sample light intensity is lower than 50%, it means :
   a) flow cell is contaminated
   b) excessive absorbance by solvent
3) An acceptable ratio of reference to sample light accompanied by a reference light level less than 30 indicates the lamp to be bad.

## 5.2. Error message

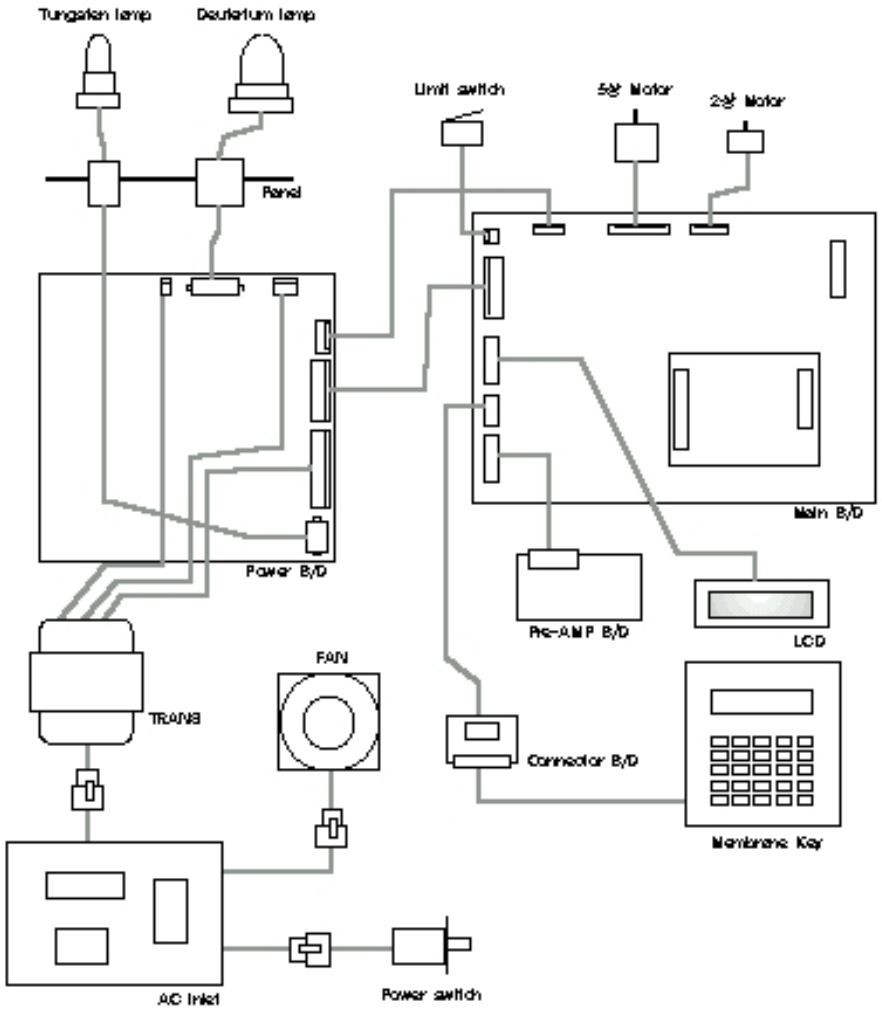
If any errors are occurred during self-diagnostics or operation, following messages are occurred. Please fix accordingly.

[**Table 5.1**] Error messages and its cause and checking

| Error message | Cause | Check |
|---|---|---|
| CMOS Back up Fail | Back up data loss | Check RAM battery. Check the voltage, 3 V |
| System voltage error | VCC, +5V DC fail | Check VCC(TP4) and fuse F3 |
| | VDD, +15VDC fail | Check VDD(TP5) and fuse F4 |
| | VSS, -15VDC fail | Check VSS(TP6) and fuse F5 |
| | +12VDC fail | Check the power for motor and relay |
| Lamp ignition fail | Lamp not turn on | Check the fuse F1 and F2 |
| Grating drive has not Work properly | Limit switch<br>5 phase motor | Check pin connection on J6<br>Check pin connection on J4 |
| Pre-amp B/D and filter Drive have not work properly | Lamp not turn on<br>Light path is blocked | Check fuse F1<br>Check cut filter blocks light path |
| Pre-amp B/D has not Worked properly | Data from pre-amp is not normal | Check R and S value on service mode |
| Filter drive has not Worked properly | Filter drive can not move To initial position | Check filter drive movement |
| Flow cell is contaminated Or not aligned properly | Contamination<br>Misaligned cell | Check contamination of cell window |
| Optical assemblies are Misarranged | Fail to calculate wavelength | Check mirror position |
| Cut filter check | $2^{nd}$ cut filter | Check light intensity |
| W lamp ignition | Lamp not turn on | Check fuse F7 |
| DA/AD check | Analog-Digital conversion | |

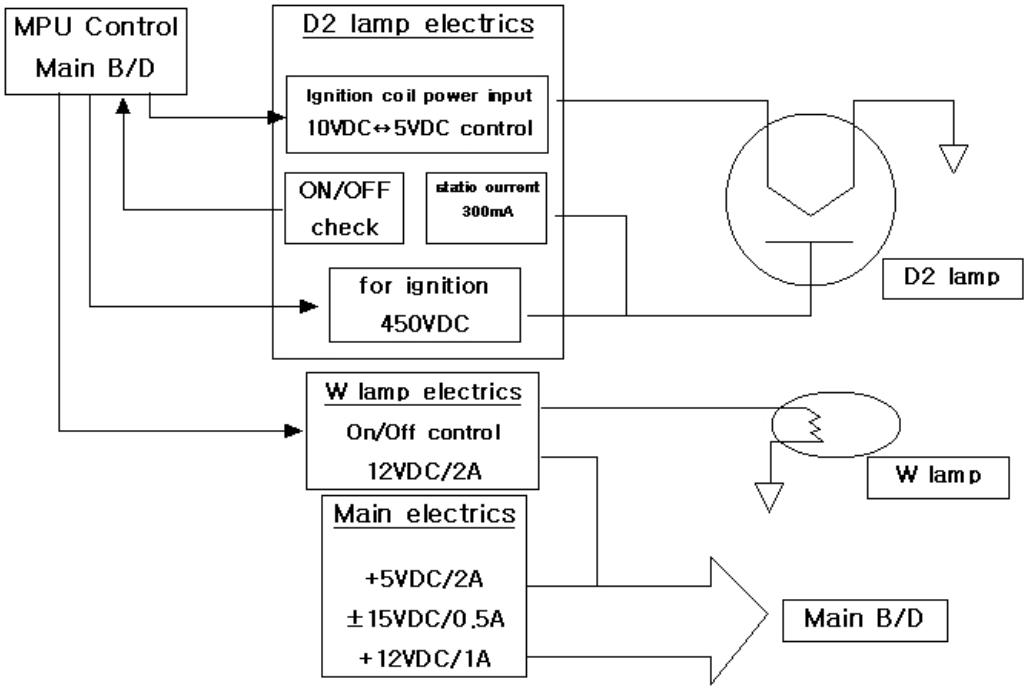
## 5.3. Configuration diagram

### 5.3.1 Connection diagram of the UV/Vis Detector



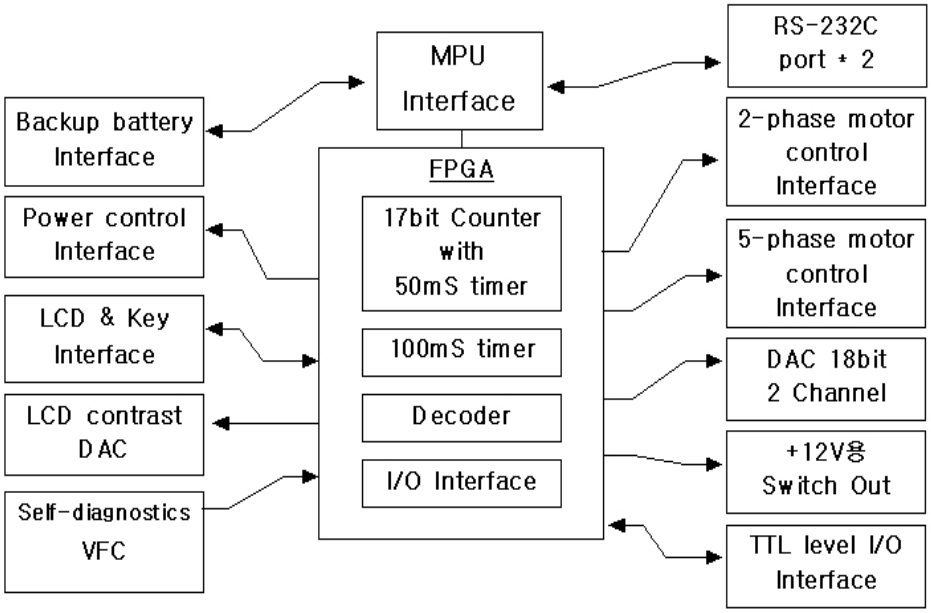

[**Fig 5.1**] The circuit diagram of the UV/Vis Detector

### 5.3.2 Configuration of the power board

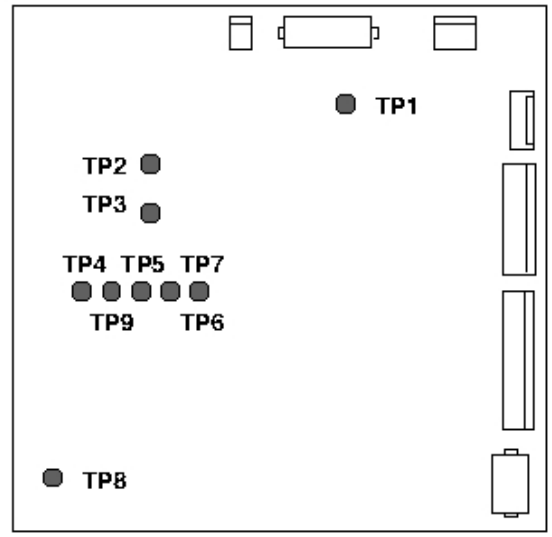



[**Fig 5.2**] The power board diagram of the UV/Vis Detector

### 5.3.3 Configuration of the main board

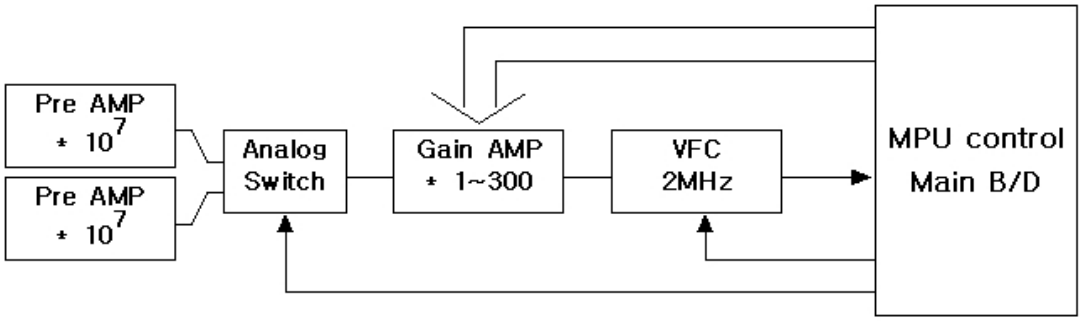



[**Fig 5.3**] The configuration of the main board



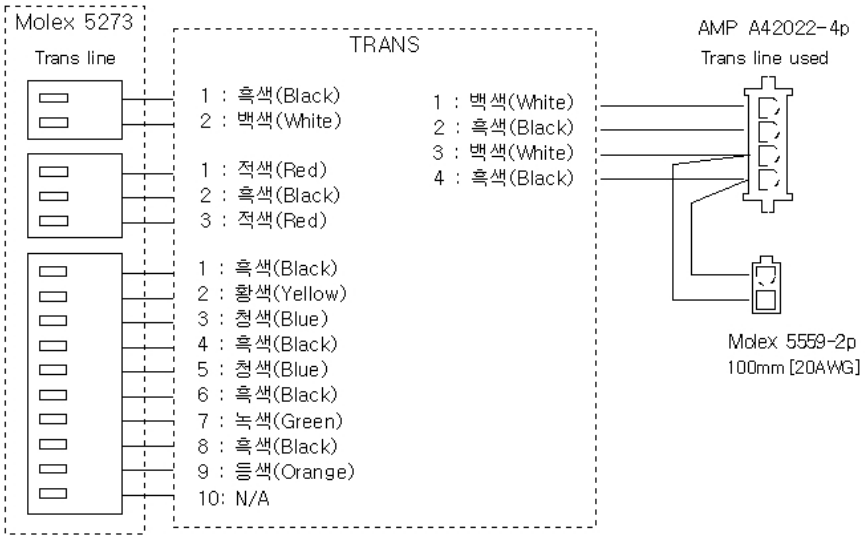

[**Fig 5.4**] The main board circuit diagram

### 5.3.4 Configuration of the pre-amp board

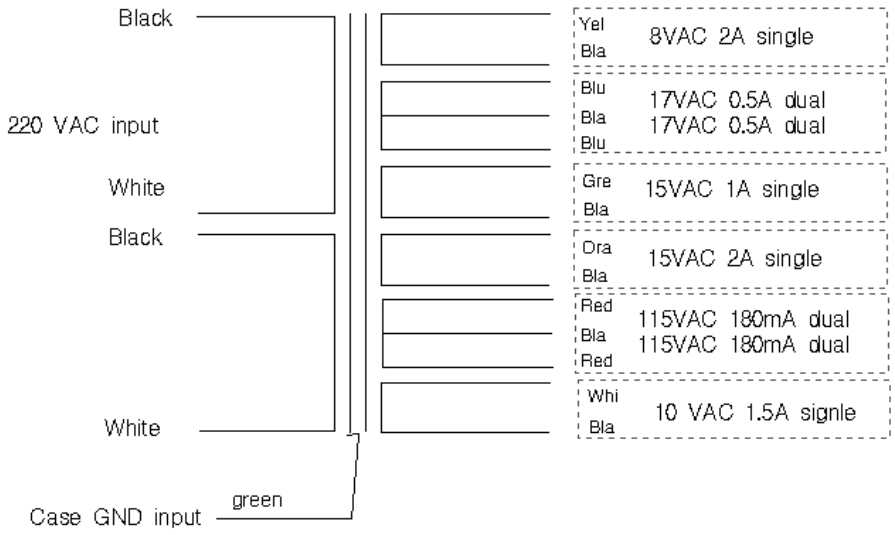



[**Fig 5.5**] The configuration of the pre-amp board

### 5.3.5 The connection of a transformer

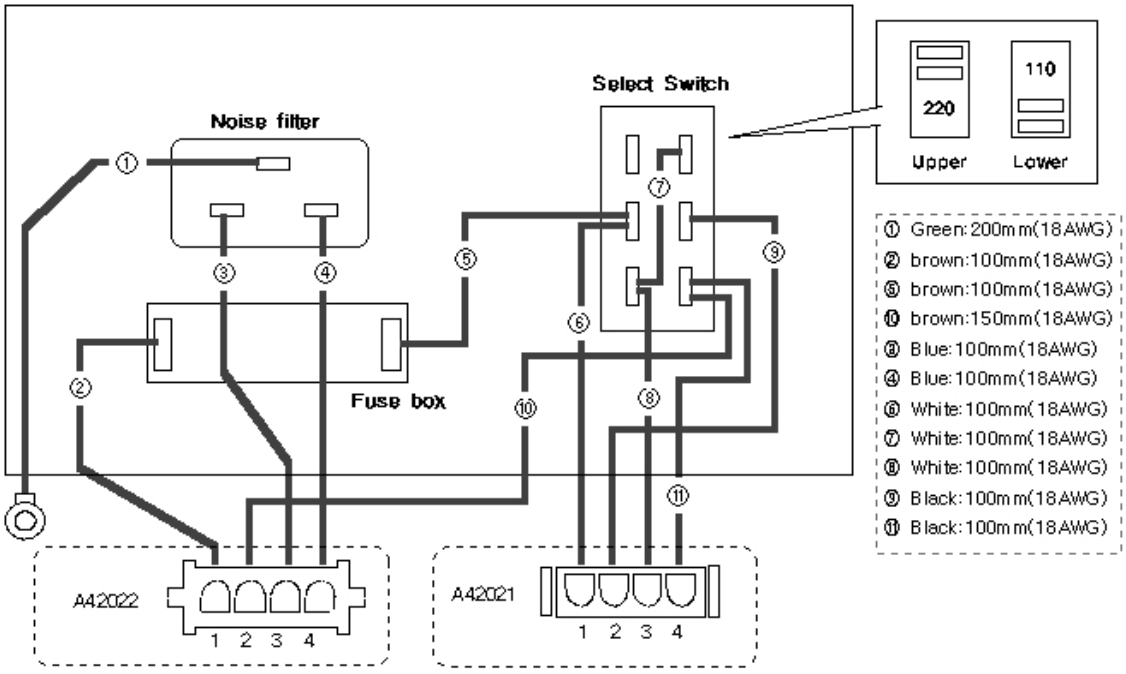



[**Fig 5.6**] The connection of a transformer




[**Fig 5.7**] The electricity of a transformer

## 5.3.6 The AC inlet connection




[**Fig 5.8**] The AC inlet connection

## 5.4. Trouble shooting guide

Remaining noise and drift problems can be due to various sources within and external to the system. The Table 5.2. provides the check list of symptoms, possible causes, and some remedies.

[**Table 5.2**] Various Problems and theirs cause and remedy

| Problem | CAUSE | REMEDY |
|---|---|---|
| 1. Spikes on baseline | Bubbles passing through cell. | Degas solvent and/or supply back pressure to the sample cell, also check all high pressure fittings for leaks(both liquid and gasses) |
| | External triggering device is creating electrical noise. | Check electrical lines for good connection and/or interference from broad cast radiation. Check for ground loops. |
| | Extremely large supply voltage transient on the AC line | Remove systems that consume high power from the AC line. |
| 2. Noisy baseline (random) | Sample cell windows are contaminated. | Flush cell with solvents(methanol, acetone, water, nitric(6N) acid, water) and check for leaks. |
| | Sample input line has a leak. | Check all lines from the output of the column to the input of the sample cell for leaks. |
| | Bubble trapped in the sample cell. | Increase flow rate and/or back pressure on cell. |
| | Recorder or integrator is grounded and is causing a "ground loop" problem. | Check recorder with voltmeter to see if either of the signal inputs is grounded to case or earth ground. |
| | Photodiode window is dirty or not held down properly to the cell holder. | Remove and clean photodiode window. |
| | Sample cell is not screwed down to the main unit. | Check sample cell mounts and cell holder assembly. |

| | | |
|---|---|---|
| | Output span of the detector does not match input range of integrator. | Press event mark to see if the "spike" is approximately 20% of scale. |
| | External triggering device is causing a ground loop problem. | Use only triggering device with ground isolated from earth ground. |
| 3. Baseline drifts excessively. | Contamination of sample cell windows has occurred. | Clean cell by flushing with solvents (methanol, acetone, water, nitric(5N) acid). Inspect cell and photodiode for fingerprints and smudges and clean if necessary. |
| | Solvent from column is changing absorption. | Column is filled with UV absorbers that are bleeding-replace column; impure solvent is equilibrating with the column-replace solvent with more pure grade, switch to a longer wavelength so that background absorption does not fluctuate as much. |
| | Leakage in the lines from column to flow cell. | Check lines for leakage. |
| | Tiny bubbles trapped in the sample cell. | Increase flow rate and/or back pressure. |
| | Output span of detector does not match input span of recorder or | Press Event Mark to see if a spike of 20% of full scale occurs. |
| | Large temperature fluctuations are occurring. | Remove detector from the source of hot and cold air. |
| | Flow cell, photodiode assembly, or flow cell cover is loose. | Tighten thumbscrews fastening flow cell holder, and flow cell cover. |

| UV/VIS Detector | | |
|---|---|---|
| 7301012040 | Analytical Flow Cell Assembly | |
| 7301012120 | Deuterium Lamp Assembly | |
| 7301012130 | Tungsten Lamp Holder Assembly | |
| 1301032120 | UV Detector Main Board Assembly | |
| 1301032130 | UV Detector Power Board Assembly | |
| 1301532140 | UV Detector Transformer Assembly | |
| 1301032470 | Pre-AMP Board Assembly | |
| 1301032160 | Connector Board Assembly | |
| 1301032170 | MPU188 Board Assembly | |
| 1301032180 | UV/Vis Detector Terminal Board Assembly | |
| 7301333010 | UV/Vis Detector Keypad & Silk | |
| 1301533210 | LCD Module (20 x 2) | |

# Vacuum Degasser & Mixer

## User Manual

YOUNG LIN INSTRUMENT

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# 1. Introduction

It is not easy but important to select and handle mobile phase solvent in HPLC(High Performance Liquid Chromatography). Vacuum Degasser & Mixer is connected a high productive vacuum Degassing module which is built in the mixer and it is equipped with a precise 4-way valve module to provide optimum solvent degassing and mixing to HPLC user.

## 1.1 Function and Feature

**Degassing of mobile phase solvent**

Solvent is degassed when passing through the vacuum degasser, solvent preparation is greatly simplified and the degassed solvent is ready to use for analysis. With an in-line vacuum degasser, you can realize excellent environment for HPLC analysis.
Vacuum Degasser & Mixer consists of four channels for degassing and each channel removes efficiently air and oxygen in the solvent. Also solvents, which were degassed by each channel, were mixed up with 4-way valve and then were degassed one time again. Therefore the Vacuum Degasser & Mixer provides the best optimized solvent.

**The solvent mixing by 4-Way valve module**

Vacuum Degasser & Mixer with 4-way solenoid valve can mix up to 4 different solvents easier and more precise than any other mixer available.

## 1.2 Specification

Max. Flow rate : 5 ml/min per channel
Degassing Channel Tubing : Teflon® AF
Degassing Channel Pressure Rate : 70 PSIG(testing pressure)
Vacuum Wetted Materials : Teflon® AF, Peek, Class-filled PTFE
Valve electrical specification : DC 12 V, 2.5 W, 211 mA, 57Ω ± 5% @ 70°F
Valve module leak rate : < 1 x 10-6 cc/sec Helium ATM
Power requirements : AC 220 V, 50/60 Hz, 25 W

Dimensions : 297 x 135 x 495 mm (W x H x D)

# 2. Installation

## 2.1 Unpacking

Open the package and carefully take out Young Lin Vacuum Degasser & Mixer. When we deliver Vacuum Degasser & Mixer, it is included the power cord, this operation manual and a letter of guarantee. Before you install, please confirm the contents correctly delivered. If not, please contact us.

## 2.2 Preparation of installation

### 2.2.1 Preparation details

When install Vacuum Degasser & Mixer at first, please prepare followings to be ready.

1) HPLC System(Young Lin Gradient Pump, HPLC Column, Injector…)
2) Nut, Parrel, appropriate fitting types
3) Appropriate wrench types
4) Mobile phase solvent

### 2.2.2 Site requirement of the Vacuum Degasser & Mixer

The conditions of appropriate installation are as follows.

1) Where the temperature is kept 5 ~ 35℃ and there is no sudden change of temperature
2) Where no generation of moisture much
3) Where no direct and straight sunshine
4) Where there is no generation of corrosive gas

## 2.3 Connecting and controlling

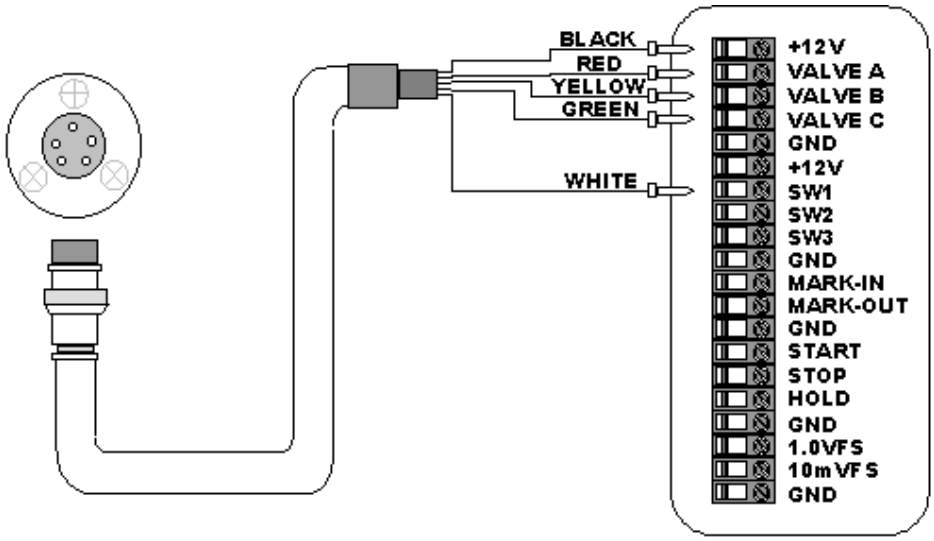
### 2.3.1 Connecting of the power

Check power, 220V and its capacity. Power consumption is 25W. Check fuses mounted above the power cable connector. The connector is rear side of Vacuum Degasser & Mixer. Fuse is 250V and T 0.5A.

### 2.3.2 Connecting of BNC Cable

Connect the BNC cable supplied with Vacuum Degasser & Mixer to the terminal of Gradient Pump as per following drawing. Check colors of cable lines. Do not make connection wrong.

**Vacuum Degasser&Mixer** **Gradient Pump**




［**Fig.2.1**］ The connection drawing of BNC cable

### 2.3.3 Connecting of tubing

## Connecting of mobile phase solvent

Vacuum Degasser & Mixer can connect 4 kinds of solvent. If you do not use less than 4 solvents, you must plug up the solvent port, which is not used. Open a dust cover in the front, you will see 8 ports. 4 ports left are for input and right 4 ports are for output. Use a plug screw supplied to plug up un-used ports.
There is solvent reservoir in the upper part of Vacuum Degasser & Mixer. Place solvent bottles on the reservoir and connect input tubes. All input tubes have in-line 10 μm solvent filter in the end to prevent minute particles from entering into pump.

## Connecting of Solvent delivery pump

Connect the mixed tube to the input of Gradient Pump. The mixed tube is located in right middle of Vacuum Degasser & Mixer. Open prim/purge valve by turning in counter-clock wise and setting mixing rate as 100% for each solvent and pull out solvent by a syringe. Check if all tubes are filled with solvent. Do not pull out quickly nor strongly, it will damage the in-line vacuum degasser. Pull out slowly until when tubes are will with solvent.

# 3. Operation

## 3.1 Degassing of the solvent

Power on Vacuum Degasser & Mixer by pressing power switch, which is located in the front. When you power on, check if pump is stopped, otherwise stop pump before turning on Vacuum Degasser & Mixer. Vacuum Degasser & Mixer will start immediately to degas solvent. If normally operational, green LED located far left is twinkling. Time of LED on is getting longer when degassing is proceeding, wait for until time LED on is more than 20 seconds. Usually it takes 5 ~ 20 minutes to degas complete but can be shorter or longer depending on solvents.
Do initialization until when complete degassing is made.

## 3.2 Operating of solvent delivery pump

Set mixing rate constant for all solvents and start pump at flow rate of 1.0 ml/min. Air bubble will be coming when start. To remove the bubble, open the prime/purge valve and pull out air bubble by syringe slowly until the bubbles are removed. After remove, close the valve for normal use of pump.

## 3.3 Replacing solvents

When necessary to replace solvents during analysis, stop pump and replace solvents and re-start pump. But do not turn off Vacuum Degasser & Mixer. If you want to change solvent filled inside if Vacuum Degasser & Mixer completely, set mixing rate at 100% for the solvent, pull out more than 15 ml solvent by syringe or start up pump and wait until solvent is completely changed.

## 3.4 Keeping method after use

If you do not use Vacuum Degasser & Mixer more than 1 day, use ultra pure water and flow into vacuum degasser and rinse with alcohol completely and keep it. Specially when use with buffering solution, be sure to rinse Vacuum Degasser & Mixer, otherwise precipitation can be occurred. In the case Vacuum Degasser & Mixer is kept lower than 0℃, dry completely after rinse.

# 4. Maintenance

## 4.1 Filtration of solvent

Be sure to filter solvent by <5 μm when specially use buffering solution. Keep filtered solvent in the bottle, which is cleared from minute particles. When use filtered solvent, which kept more than 1 week, please filter again before use.

## 4.2 Caution of use

1) Do not pressurize the vacuum degasser module. More than 120 kPa pressure will damage degassing membrane inside. When you put solvent bottles 2 m higher than degasser, the pressure is approximately 120 kPa. So place the bottles less than 2 m lower.
2) Be sure to prevent from any contamination when you connect or disconnect tubes. Entering fine dust will reduce degassing efficiency greatly.
3) If you want to increase degassing efficiency, make parallel connection of input port to output port. Do not connect it by serial way.
4) Can not use Vacuum Degasser & Mixer for output of solvent delivery pump.

## 4.3 Diagnosis of malfunction and remedy

1) Error and malfunctioning

Errors of Vacuum Degasser & Mixer are occurred when ……
a) Not approach normal vacuum state 15 minutes after power on.
b) Vacuum pump operates continuously more than 15 minutes.
c) Rapid pressure drops by solvent leak during normal operation.

When above errors occurred, degasser will alarm with turning red LED and stop automatically. Open above

solvent reservoir and check if vacuum lines are installed correctly. If you cannot find any thing wrong, please contact us or our representative. In order to re-start, turn off and wait for more than 5 seconds and turn on.

2) Malfunctioning of 4-way solenoid valve

There are a green LED for power and a red LED for valve in the front. They display the status. If the power LED or any of valves LED is not on, check if the pump is on and confirm the connection of BNC cable. Refer to the connection drawing of BNC cable. If the problem is not solved, please contact us or our representative.

3) Continuous air bubbling

If air bubbles are continuously happened after turning Vacuum Degasser & Mixer on more than 1 hour, check if input and output port and valve fitting are completed connected. Do not tighten the screw. Fitting and joint part can be damaged. If the problem is not solved, please contact us or our representative.

# Column Oven

## User Manual

YOUNG LIN INSTRUMENT

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# 1. Introduction

Young Lin Column oven is excellent oven used for HPLC to maintain and program column temperature. The Column Oven has various functions and self-protection. Also it uses PID to control temperature and uses an air-forced heat exchange technology to enhance temperature precision. With RTD temperature sensor used for control, it provides accurate temperature control in wide range of temperature. Following table describes the standard specification of the column oven

[**Fig. 1.1**] The Young Lin Column Oven.

[**Table 1.1**] The specification of the Column Oven

| | Specification |
|---|---|
| Control Method | Forced Air Heat Exchange, PID Control |
| Temperature range | Ambient +5 – 80℃ |
| Accuracy | ±0.2℃(whole range) |
| Precision | ±0.1℃ |
| Stability | ±0.05℃ |
| Oven Dimension | 160mm × 140mm × 400mm ( 4 columns, 20mm × 30cm) |
| Heating rate | 5℃/min |
| Cooling rate | 1℃/min |
| Temperature program | 20 files 40steps/19 curves possible, maximum 999min |
| Safety | Maximum temperature/leak sensor/Over temperature block /Flammable gas sensor |
| Installable option | Manual injector, Column switching valve, Damper, Mixer, |
| LCD display | Temperature/Setup value/Error, 16 character x 2 lines |
| Communication | RS-232C protocol for temperature control protocol |
| External input | Start/Stop |
| External output | Hold, Mark-Out |
| Voltage | 110/220V 50/60Hz, 3A |
| Dimension | 210mm(W)×550mm(H) ×400mm(D) |
| Weight | 19.5Kg |

# 2. Unpacking and Installation

## 2.1. Unpacking

Unpack the box and pull out the column oven carefully. Confirm the serial number between that of rear panel and that of final inspection test sheet. Also confirm the voltage stated on the rear panel carefully if it is matched with one that you use. The Column Oven is set as 220V at our factory. Also confirm the packing list if all accessories are included in the box. If any of them are missing or defective, please contact local supplier or Younglin Instrument.

## 2.2. Installation

As HPLC uses large amount of solvents which can damage or be volatile when leak, please be careful.

1) Vent utility should be equipped.
2) Relatively stable room temperature. No straight light such as window side.
3) No dusts and vibration.
4) Maintain the voltage within ± 5% variation.
5) No high frequency nor strong electro-magnetic field.
6) Avoid the site from fire, spark and flame.
7) Be sure to ground.
8) Drain should not be blocked.

***Note ! :*** **Do not install closed to CRT, monitor or TV which the Column Oven can affect the display. Please place at least 50 wider.**

***Note ! :*** **The column oven emits heat at rear part, so minimum 10 cm is required between wall.**

## 2.3. Power input

The column oven is set as 220V at the factory. Please be careful to confirm your power voltage. If you use 110V, please change the voltage for the Column Oven as per **2.4 Power Selection**.

***Warning ! :*** **If the setup power voltage is different from your power voltage, the Column Oven can be fatal damaged and caused for fire.**

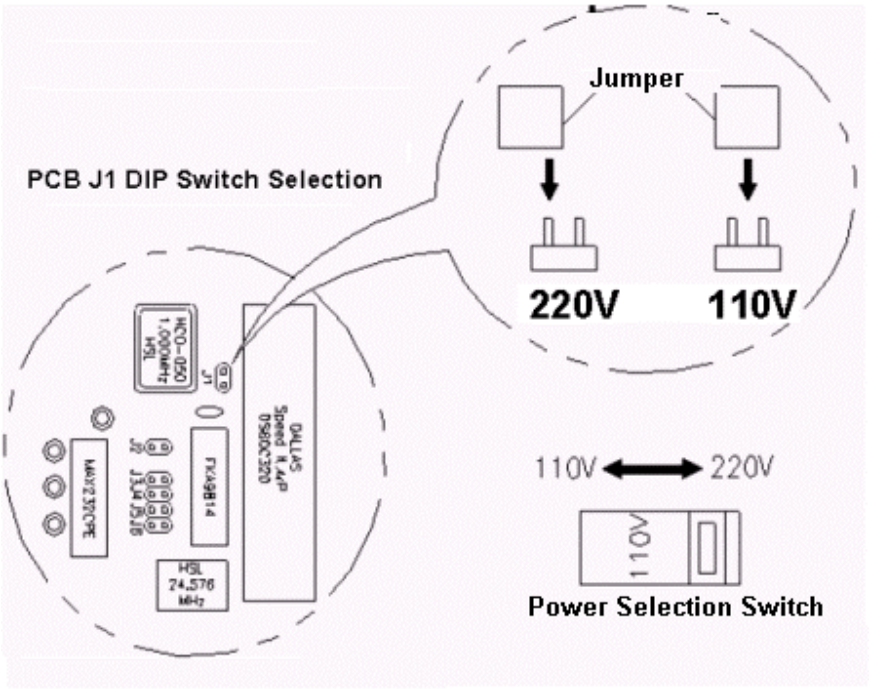
***Note ! :*** **Please be sure to ground the Column Oven. The tap water pipe can not be used for the earth because the pipe is not made completely of metal. Also gas tube should not be used due to safety. No proper earth can cause electric shock.**

After confirming the power voltage, close the door of the column oven and input the power cable and switch on.

## 2.4. Power Selection

If you want to change the voltage from 220V to 110V, follow the instructions as below.

1) Switch OFF.
2) Open and detach the upper cover after unscrew four bolts.
3) Select the power selection switch to the voltage that you want to use.
4) Open the PCB J1 DIP switch for 220V and connect the switch for 110V.
5) Close the cover and screw the bolts.

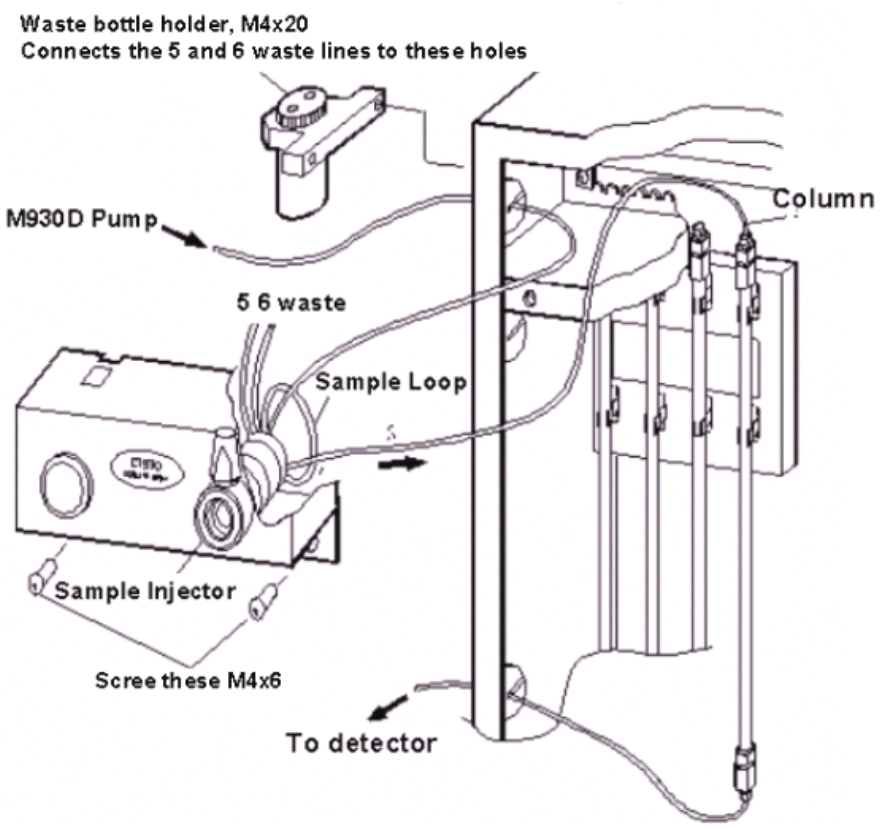



[**Fig 2.1**] Power Selection.

## 2.5. Installation of Manual Sample Injector, Column Switching Valve and Columns

If the injector or the valve is ordered with column oven, they are already installed at our factory. However if ordered separately the injector or valve can be field installed. Follow instructions as below. The columns should be installed by yourself.

1) Open the door and unscrew the bolts which are at upper side of the door.
2) Detach the valve mount by proper strength.
3) Install the injector or valve as per instructions of Rheodyne or Valco.
4) Connect the tubes through the white hole holders at each side of the Column Oven. The tube length can be 30cm longer than that of required length for convenience.
5) Connect the waste line 5 and 6 of the injector to the holes of the waste bottle holder.
6) After all connection made, assemble the valve mount and tight by screwing the bolts.
7) After assemble the valve mount, connect the injection tube of the injector to the column and column outlet to the detector.

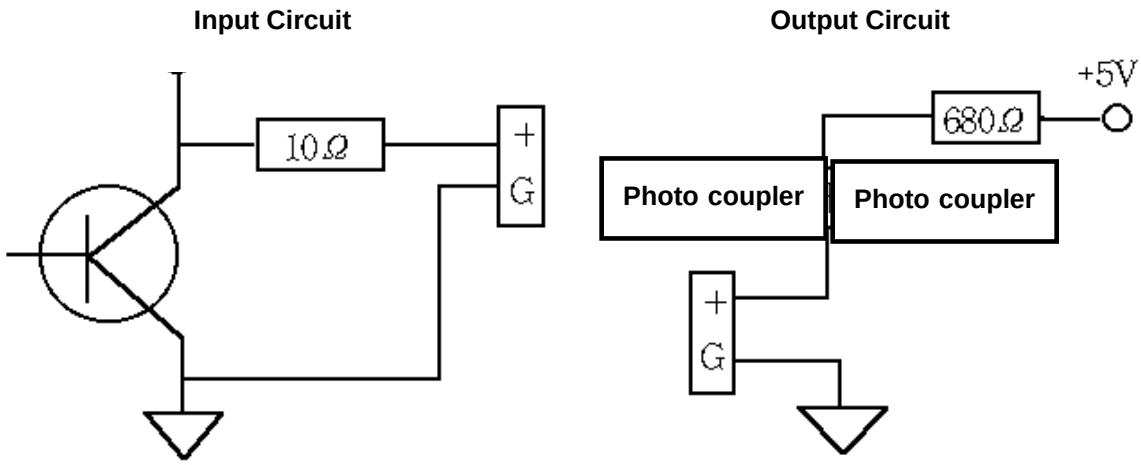



[**Fig 2.2**] Installation of Injector and Column.

## 2.6 Connection of terminals and communication cable

The terminals located at rear panel are used for consecutive operation with other instruments such as Gradient Pump and the RS-232C communication is used for control or reading temperature of the Column Oven. Terminal input works when short and the terminal output TTL voltage.

***Note ! :*** **When a terminal input is connected with other instrument's terminal input, the terminal input may not work. In this case, confirm other instrument's input circuit so that the terminal input can work. Also refer to the terminal I/O circuit as follows.**




[**Fig 2.3**] Circuit Diagram of Terminal I/O.

1) Terminals and their functions

**[ START ]**

Used for start of a temperature program.

**[ STOP ]**

Used for stop of a temperature program.

**[ MARK-OUT ]**

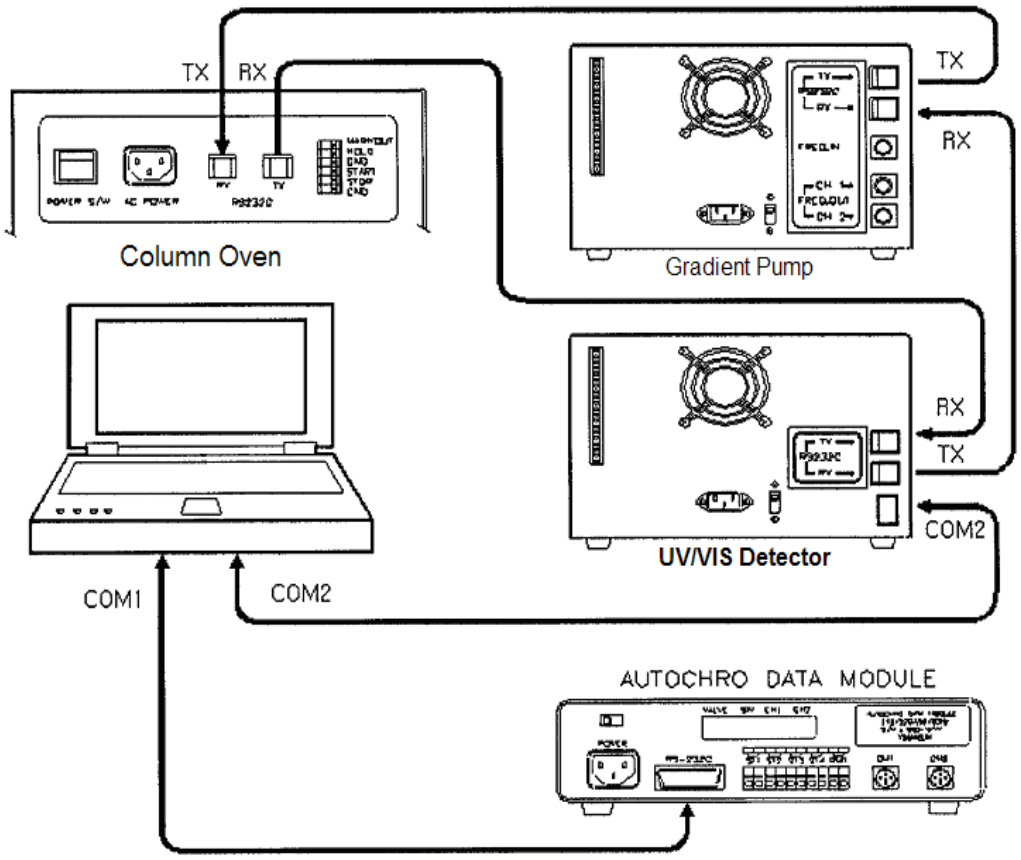
Start of a temperature program and output a pulse by communication command.

**[ HOLD ]**

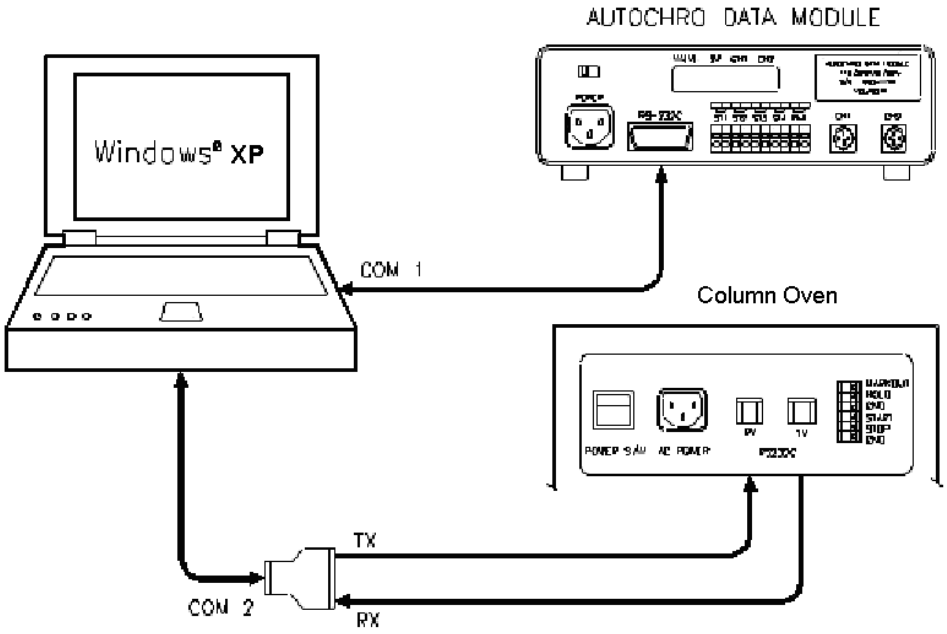
Used for output of the Column Oven status to external instrument. When the Column Oven is ready, output "TTL LOW Status to the terminal.

2) Connection of the RS-232C cable

The Column Oven communication is industry standard RS-232C. The data bit is 8 bit, the parity is none and the stop bit is 1 bit. The connection of the RS-232C cable is shown on Fig 5. and is configured as closed circuit with Gradient Pump and UV/Vis Detector.




[**Fig 2.4**] RS-232C Connection with Gradient Pump and UV/Vis Detector.




[**Fig 2.5**] RS-232C Connection with Autochro-2000.

# 3. Operation

## 3.1 Front Panel

The front panel is consisted of LCD, LEDs for status display and keyboard. The LCD is 16 characters and 2 lines and displays as per key operation.

| YOUNGLIN CTS30 |
| --- |
| First & Best |

The LEDs for status display are turning on as follows

⊙ **Power** : When power is on.

⊙ **Ready** : When the temperature is stable.

⊙ **Remote** : When the Column Oven runs by external control.

⊙ **Reset** : When any of errors occurred.

The keys are used for followings.

**OVEN** : Move to mode selection, Isothermal, Remote, Programmed Op. and set the temperature Limit

**PROGRAM** : Create a file for temperature program.

▲ : Move up each setting parameter and select displayed parameter.

▼ : Move down each setting parameter and select displayed parameter. Also used for releasing Reset.

**START/STOP** : Start the oven heater and temperature program when the mode is Program Op.

**ENTER** : Input of values.

## 3.2. Self-diagnostics

After turning on the Column Oven, on the LCD initial display is appeared and self-diagnostics is executed.

| YOUNGLIN CTS30 |
|---|
| First & Best |

| YOUNGLIN CTS30 |
|---|
| *Column Oven* |

If no errors during the self-diagnostics, the Column Oven immediately turns to ready status for oven temperature input by operator or external communication.

| Ver X.XX SelfTest |
|---|
| .....OK! |

If any errors are occurred, the Column Oven initialize the data of CMOS RAM and execute the self-diagnostics again.

| Ver X.XX SelfTest |
|---|
| CMOS Data Fail! |

| Ver X.XX SelfTest |
|---|
| Data Initialize |

| Ver X.XX SelfTest |
|---|
| RS232C=19200bps |

| Ver X.XX SelfTest |
|---|
| .....OK! |

After finished the self-diagnostic, followings are displayed. However if you use the Column Oven as external communication, "REMOTE" is displayed repeatedly.

| Act | Set | Limit |
|---|---|---|
| 25 | 25 | 80 |

| *Remote* | | |
|---|---|---|
| 25 | 25 | 80 |

If press following keys within 3 seconds after switching on, the keys operate as follows.

**[OVEN]** : Corrects the values for initialization.

**[START/STOP]** : Explains key operation shortly.

**[ENTER]** : Initializes the data of CMOS RAM for initialization.

## 3.3 Isothermal Operation

After above initialization is finished, if present mode is isothermal, followings are displayed.

| Act | Set | Limit |
|---|---|---|
| 20 | OFF | 80 |

| Isothermal Input |
|---|
| Operation! |

At this status, the heater is not turn on yet. If you want to turn on the heater and increase or decrease the temperature, press the Start button and select the temperature using ▲or the ▼key and the ENTER key, then the heater is on.

| Act | Set | Limit |
|---|---|---|
| 20 | 35 | 80 |

The upper temperature can be set up to 80℃. When oven temperature is over this limit, the heater is automatically off and error message is displayed. The upper temperature limit is also applied during oven temperature program or remote operation. If you want to execute isothermal operation during other operation, press the OVEN key.

## 3.4. Temperature Program

The Column Oven can program oven temperature according to time. Press the Program key, then displayed as follows.

| Program Edit! |
|---|
| Key Lock : No |

The key lock is used for protection from other user's input. If you want to release the key lock, please press the keys ▲,▼, OVEN, PROGRAM consecutively.

| File Number: 1 |
|---|
| Clear File : No |

The temperature program can be edited for file No. 0 to 20 while each file is consisted of 41 lines.

| ID | TIME | SET | CV |
|---|---|---|---|
| 00 | init | 20 | * |

Edit a temperature program file as follows.

1) Add one line : When the cursor is on the ID, press the ENTER key. Input oven temperature and temperature curve number consecutively then the cursor returned to the ID and adding one line is finished.

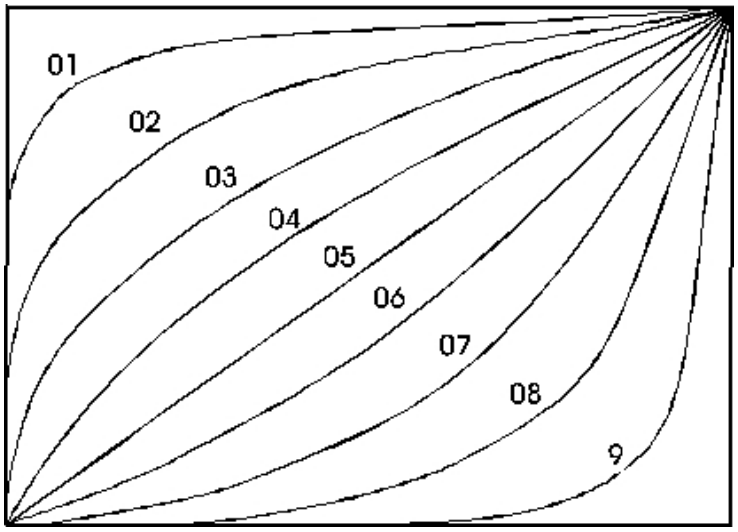
2) Delete one line : When the cursor in on the ID, after confirm the ID which is really deleted that you want, press the Program key.

3) Search a file contents : When the cursor is on the ID, press the ▲or the ▼key to see a file contents.

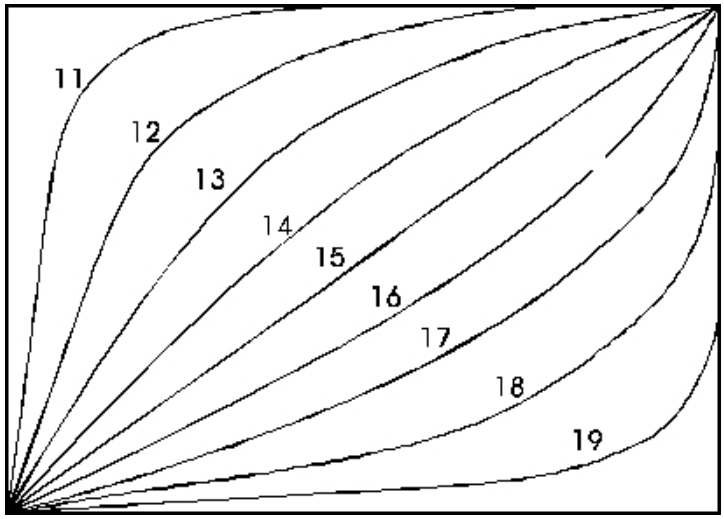
| ID | TIME | SET | CV |
|---|---|---|---|
| 01 | 19 | 20 | * |

When you program oven temperature, consider the heating and the cooling rate for the Column Oven, otherwise it will not work properly. The curve types for oven temperature program can be used from 00 to 19

and each curve is shown on Fig 7. and Fig 8. The curve No. 5 and 15 are linear programming and No. 00 is for temperature change at the end of line while No. 10 is for temperature change at the start of line.




[**Fig 3.1**] Various Curves for Temperature Program from 00 to 09.




[**Fig 3.2**] Various Curves for Temperature Program from 10 to 19.

## 3.5. Execution of Temperature Program

Press the Start/Stop key and input a file number to execute a file for temperature program edited at 3.3.

| Program Execute! |
|---|
| File Number: 0 |

After input of the file number, following is displayed.

| ID | TIME | SET | CV |
|---|---|---|---|
| 00 | init | 20 | 05 |

At this display, if you press the Start/Stop key consecutively, the Column Oven turns to temperature program status from initial status, turns to temperature program stop(heater off) status from temperature program status and turns to initial status from temperature program stop.

| ID | TIME | SET | CV |
|---|---|---|---|
| 00 | 0.5 | 20 | 05 |

(Temperature program)

| ID | TIME | SET | CV |
|---|---|---|---|
| 00 | 0.5 | OFF | 05 |

(Temperature program stop)

At this display, press the ▲or the ▼key to display current temperature and upper temperature limit.

| Act | Set | Limit |
|---|---|---|
| 25 | 20 | 80 |

| ID | TIME | SET | CV |
|---|---|---|---|
| 00 | 0.5 | 20 | 05 |

If you want to call another file, press the ENTER key. The new file does not affect the file which is on use.

| Program Execute! |
|---|
| File Number: 0 |

## 3.6 Error Messages

The Young Lin Column Oven displays various error messages with beep sound when any errors are occurred. There are following operation errors. When error message is occurred, take measure to remove the error and press the ▼key. However any of communication errors are automatically disappeared within few seconds. In case error message can not be disappeared, refer to 4. maintenance part or contact us.

| | |
|---|---|
| Flammable Gas ! | High temp limit ! |

| | |
|---|---|
| Solvent leak ! | Door opened ! |

| | |
|---|---|
| Communication<br>Error > Command | Communication<br>Error > Value |

| |
|---|
| Communication<br>Error > ID |

During oven temperature programming, if Start or Stop signal is received at rear terminal, following message is appeared with beep sound.

| | |
|---|---|
| Remote Start | Remote Stop |

## 3.7. Remote Operation via Communication

Column Oven can be controlled by Autochro-2000(or Autochro-3000) software. In this case, Column Oven has to be set remote mode. Details are described on the Autochro-2000 (or Autochro-3000)software manual.

## 3.8. Setup

Press the OVEN key within 3 seconds within turning on, you can edit parameters for initial setup.

1) Instrument ID and baud rate.

| Instrument ID: 5 |
| --- |
| RS232C: 19200bps |

The instrument ID can be setup from 0 to 9 for communication. Default ID of column oven is 5. Select the baud rate as any of 9600, 19200 and 38400bps.

2) Safety detection

| Gas Detect : Yes |
| --- |
| Leak Detect: Yes |

Select the safety function for flammable gas and solvent leak to use.

3) Temperature display unit

| Temperature Unit |
| --- |
| : Celsius |

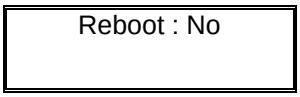
Select the temperature unit as one of Celsius or Fahrenheit that you want.

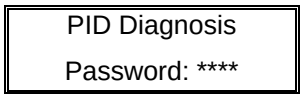
4) Input of lower temperature limit

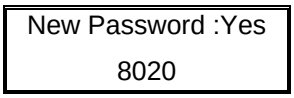
| Door Open Limit |
| --- |
| : 60 |

Input lower temperature limit to display error when open the door. Means If open the door when Column Oven is ready status and current temperature is over 60 Celsius degree, the error message is appeared.

5) Setup password for PID constants

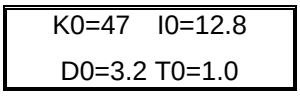



Setup the password to input PID control value in order to track the oven temperature. After passing identification, you can edit the value. The default password is 8020. Failure of identification displays Reboot : No display for restarting the Column Oven.

6) Input of PID constants




The column oven control oven temperature by digital PID. The PID constants can be inputted from 0 to 160 degree by 16 degree segment. K is proportional coefficient, I is integral coefficient, D is differential coefficient and T is integration and differentiation time.

# 4. Maintenance

When any of error messages are appeared, refer to table 2. and remove the cause.

[**Table 4.1**] Error messages and their Cause

| Error message | Cause | How to fix |
|---|---|---|
| High Temp Limit! | Over upper temperature limit | Increase upper temperature limit or decrease current temperature |
| Solvent Leak! | Leak on the oven inside | Remove cause of leak by replacing fittings or tubes and clean oven bottom |
| Door Opened! | Door is opened during heater working or when door open limit | Decrease current temperature and close |
| Flammable Gas! | Leak of volatile solvents by loosening fittings or in-flowing volatile gases | Open the door and ventilate inside and remove cause. |

Various problems occurred during use are described in the Table 3.

[**Table 4.2**] Problems and their fixing

| Problem | Cause | How to fix |
|---|---|---|
| Current temperature is over setting temperature | Electric problem | Turn off and contact us |
| Heating does not work | Heater does not work | Contact us |
| No LCD display nor normal display | 1) Fuse out<br>2) Electric problem<br>3) Input voltage wrong | 1) Replacement of fuse<br>2) Contact us<br>3) Change input voltage or Column Oven's voltage |
| Stop and no function | 1) Over heat<br>2) Fuse out<br>3) Electric problem | 1)Turn off and after 10 minute turn on and use<br>2) Replacement of fuse |
| Key input does not work | 1) Key locked<br>2) Board problem | 1) Release key lock<br>2) Contact us |

| Column Oven | | |
|---|---|---|
| 5501032090 | Key board ass'y | |
| 5501012040 | Solvent leak sensor | |
| 5501012030 | Oven fan motor ass'y | |
| 5501032060 | Main Board | |
| 1301533210 | LCD Module | |
| 5501533270 | Oven heater coil | |
| 5501032100 | Terminal board ass'y | |

Please contact your local supplier or us when requires service or repair after confirming followings.

1) Model number
2) Serial number
3) Purchase year
4) Detailed problem and its history
5) Cause for problem
6) Any other information available